

Aviation Week

and Space Technology

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A McGraw-Hill Publication

November 27, 1961

**Piper Preparing
All-Plastic Plane
For Flight Test**

Breguet 1150 Atlantic



Programs Seek Reductions in Jet Minimums

"I believe that the nation should commit itself to achieving the goal, before the decade is out, of landing a man on the moon and returning him safely to earth."

John F. Kennedy

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Manufacturer of more than 700,000 solid rockets, Aerojet recently fired a half-million-pound-thrust augmented plant, largest in the free world. Next: super-size solid rockets for manned space missions, with assured economy, high performance, safety and maximum reliability.

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space systems planning and engineering in a unique role

The scientists and engineers of Aerospace Corporation are in the forefront of advanced planning and systems engineering. Their unique role: critical analysis linking government and the scientific-industrial team developing space systems and advanced ballistic missiles. In this mission, Aerospace Corporation provides advanced systems analysis and planning, theoretical and experimental research, system systems engineering, initial technical direction and general technical supervision. Specific activities include investigation of techniques for improving the state-of-the-art in propulsion, structures, guidance, communications and other engineering skills related to missile/space systems, feasibility studies of new weapons systems concepts and preliminary design of promising systems, formulation of development programs, conduct of critical experiments, technical supervision of the development and test program. Immediate assignments exist for those highly skilled in these specialties and who are knowledgeable in inter-disciplinary problem solving. Men with advanced degrees are urged to contact Mr. Herndon, Aerospace Corporation, Room 100, P.O. Box 99363, Los Angeles 45, Calif.

Deposited in the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government

AEROSPACE CORPORATION





Objective: duplicate the cycle of life so man can sustain himself in space indefinitely

To leave the earth at all, man must take his environment with him. But no spaceship could hold all the air, food and water he'll need for any extended trip. His major supplies will have to be constantly purified and renewed. There can be no waste. Every drop of moisture, every smidgeon of food must be reprocessed and reused.

This means that some substitute will have to be found for the fundamental cycle of life on earth. Northrop's Bioresources Laboratory is even now developing new strains of algae as a basic food source. They are consid-

ering biological means of reclaiming waste and purifying air. Studying the effects of hard radiation on living matter unassisted by earth's atmosphere. Learning more about how life is affected by the absence of gravity. Coming to grips with all the interrelated problems of life support.

When man finally moves out to occupy space, Northrop's forefront in research will have helped to make their long-term survival possible.

NORTHROP

AEROSPACE CALENDAR

- Dec. 4-5—Bayham Metallurgy Conference, New York University's Working for Space Center, New York, N. Y.
- Dec. 4-6—Symposium: Meeting on Aerospace Support and Operations (classified) in remote of the Aerospace Sciences, Orlando, Fla.
- Dec. 5-7—11th Annual Meeting, National Air Traffic Conference, Statler Hilton Hotel, Washington, D. C.
- Dec. 5-7—Annual Convention, National Aerospace Trade Show, Statler Hilton Hotel, Washington, D. C.
- Dec. 7—Paul Thompson "Our Inheritance in Outer Space," American Society of Mechanical Engineers, Kings Auditorium, MIT, Cambridge, Mass.
- Dec. 12-13—All-Asian Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.
- Dec. 18-19—Wagler Brothers Lecture, National Housing Policy Symposium in rotation, Washington, D. C.
- Jan. 8-12-1962—Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Ohio Hall, Detroit.
- Jan. 9-11—Eighty-Ninth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.
- Jan. 17-17—Symposium on Optical Character Recognition, Department of the Interior, Auditorium, Washington, D. C. Sponsored by Information Systems Research Office of Naval Research and Research Information Center/National Bureau of Standards.

(Continued on page 6)

AVIATION WEEK and Space Technology

November 27, 1961

Vol. 25, No. 22

AVIATION WEEK and SPACE TECHNOLOGY is a national weekly magazine devoted to the aerospace industry. It is published by the National Aeronautics and Space Administration (NASA) and the Department of Defense. The magazine is published weekly, except for two issues which are published bi-weekly. The magazine is published by the National Aeronautics and Space Administration (NASA) and the Department of Defense. The magazine is published weekly, except for two issues which are published bi-weekly. The magazine is published by the National Aeronautics and Space Administration (NASA) and the Department of Defense. The magazine is published weekly, except for two issues which are published bi-weekly.

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Command and Control Systems • Air Defense, Space Vehicles, Air Traffic

AEROSPACE CALENDAR

(Continued from page 5)

- Jan. 22-24**—Annual Meeting, Ballistics Assoc. of America, Marriott Motor Hotel, Dallas, Tex.
- Jan. 22-24-30th**—Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. (Evening Night Dinner), Jan. 23.
- Jan. 23-24**—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Rensselaer University, Troy, N. Y.
- Jan. 24-26**—Annual Symposium on Transient Phenomena, Princeton, N. J. (Sponsored by the American Institute of Aeronautics and Astronautics).
- Feb. 6-7**—Symposium on Radiology Techniques for Computing Systems, Department of the Interior, Anderson, Wash. (Sponsored by the American Institute of Aeronautics and Astronautics).
- Feb. 7-9**—Third Winter Conference on Military Electronics, IRE, Ambassador Hotel, San Angelo.
- Feb. 14-16**—International Solid State Circuit Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.
- Feb. 19-21**—Aerospace Electronics and Teaching of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.
- Feb. 27-Mar. 3**—Third Annual Symposium on Nondestructive Testing of Aircraft and Marine Composites, Long Beach, Calif. (Sponsored by the American Society of Nondestructive Testing, Southwest Research Institute).
- Feb. 27-Mar. 3**—Symposium on the Application of Breaching Theory in Space Technology, Fairchild, Calif. (Sponsored by Lockheed Aircraft Corp., Air Force Office of Scientific Research).
- Mar. 4-6**—English Specification and Standards, American Rocket Society, IRE, Sheraton Hotel, Washington, D. C.
- Mar. 9**—Sixteenth Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Sheraton Hotel, Houston, Tex.
- Mar. 9-10**—Institute of the Aerospace Sciences' Flight Propulsion Meeting (Jointly Held), Cincinnati, Ohio.
- Mar. 14-16**—Electronic Propulsion Conference, American Rocket Society, Hotel Chalmers, Berkeley, Calif.
- Mar. 26**—Thirtieth Annual Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.
- Mar. 28-29**—Third Symposium on Ring Currents, Agency of Magnetospheric Physics, University of Rochester, Rochester, N. Y. (Sponsored by the American Institute of Electrical Engineers, Institute of the Aerospace Sciences, Institute of Radio Engineers, University of Rochester).
- Apr. 14**—Solid State Conference, Airport Convention Center, Sheraton Hotel, Washington, D. C.
- Apr. 15**—Lunar Vehicle Systems and Materials Conference, American Rocket Society, Rensselaer University, Troy, N. Y.
- Apr. 24-26**—National Aerospace Meeting, including production issues, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

TELEMETRY SIGNAL CONDITIONING

Problem: Meeting the existing and varied requirements imposed by an increasing number of power sources and S/C.

Solution: A multiple option approach with features dependent upon the specific job. Features include: input buffer, low level power regulator, transient suppression and calibration insertion with the unique Endevco "charge" amplifier.

Mechanical Impedance Measurements

Problem: Accurate measurement of structural impedance without significantly affecting the dynamic characteristics of the structure.

Solution: A very stiff and small combined force accelerometer transducer incorporating the highly practical carrier mounting configuration. The Endevco Model 2210 Impedance Head and Model 2003 Force Transducer provide the ideal combination for accurate point measurement.

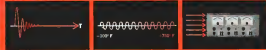
Low G Measurements

Problem: Broadband measurements at less than 0.0001 g with adequate signal-to-noise ratio. The U.S. Navy—space applications—specification is an example (MIL-STD-740 (Rev. 1973)).

Solution: High output accelerometers, low noise battery operated preamplifier, system protection against ground loop and stray field noise pickup. The Endevco 2670 and 2670H1 Systems provide these advantages.



SIX DYNAMIC ANALYSIS PROBLEMS SOLVED



SHOCK AND IMPACT MEASUREMENTS

Problem: Response, high resonance frequency and low frequency response to measure transients with amplitude and pulse widths cover a wide dynamic range.

Solution: Model 2225 Accelerometer with 80 Kips resonance frequency, the amplifier with flat low frequency response below 2 cps, wide dynamic range AC time constant adjustment.

EXTREME TEMPERATURE MEASUREMENTS

Problem: Measurements at cryogenic and/or elevated temperatures.

Solution: Model 2245 Accelerometer operates at -300° F to +750° F with self-enclosed wiring. Built-in shock accelerometers operate with mounting system temperatures of 2250° F. Other accelerometer amplifier systems incorporate built-in compensation for extreme temperature stability throughout designated ranges.

COMPLETE LABORATORY SYSTEMS

Problem: Monitoring and/or recording dynamic outputs of test systems from piezoelectric transducers.

Solution: Endevco Model 2700S DYMA MONITOR. One integrated system with simple calibration procedure, no taped live signal attenuation and a built-in XTRM and galvanometer recorder amplifier.

For complete technical information about Endevco products write Department "D" or telephone E80921.

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MICRO SWITCH Precision Switches



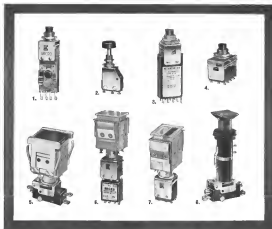
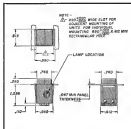
Reliable snap-action switches

Here is a new concept in ultra-small pushbutton switches for control with integral simultaneous visual indication. Switches in this series are designed for control panels in missile, rocket, launcher, marine and ordnance applications—wherever space and weight are important factors.

In less than one cubic inch, double-pole double-throw switching, two integral lamps, choice of 15 combinations of two-color display screens, Alternate-action operation (push on—push off). Designed to conform to MIL-S-6743, MIL-S-8344, and MIL-E-8222.

Within the assembly are two SPOT switches, rated 7 amps, 115-250 vac or 28 vdc. A 5-volt subminiature lamp is under each half of display screen and there are 15 combinations of color display available. The complete unit snaps into panels 6.64 in. thick or greater. No installation tools needed. Minimum mechanical life is 100,000 operations. Leneo life is 80,000 hours at rated load.

Available in the same size are a momentary-action switch, and an indicator unit without switching function.



for control panels

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Immediately available are hundreds of small size switch units with variations in dimension, electrical capacity, shape, appearance and circuitry. All have undergone thorough tests in the most complete test laboratory of its kind.

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1. Electronic switch-circuit for bounce-free voltage output.
2. Light lamp, rapid reset pushbutton.

3. Synchronized "one-shot" pulse circuit.
4. Compact, 4 pole capacitor pushbutton.
5. Lighted pushbutton, modular design, barrier mount.
6. Lighted pushbutton, electronic "one-shot" switch circuit.
7. Two-color lighted pushbutton, snap in flange mounting.
8. Brushing mount lighted pushbutton, high capacity, 30-amp switch.

For more information and for experienced help in selection, contact one of our many branch offices listed in the Yellow Pages, or write for Catalog #7 and Bulletin 22.



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ASK ALPHA:

What's being done to perfect satellite relay for long-range communications?

Many things. An active development program is making material progress toward low-cost systems for communication by passive reflector satellites. Another project is development of facilities, techniques, and equipment for ground-space-ground transmission of multiple-channel voice and high-speed data. There's a new 60-foot diameter antenna of very high precision. It's all happening as part of a continuous program in communication via satellite being carried out by Alpha Corporation and the parent Collins Radio Company. The antenna—a steerable, parabolic system—is being installed at Alpha's space communication research station in Dallas. Here, the Space Systems Division is enlarging on experiments which already have used the moon and Echo I as relays in worldwide communication circuits. Next step, to transmit multiple channel voice and high-speed data between the U. S. and England, France, and South America, using passive repeating satellites and multiple passive reflector satellites.

There's much more to tell. And it's well worth hearing, if you're seeking new techniques, new facilities, or broad system capability in space communication. Ask Alpha! Alpha Corporation • Dallas, Texas • A division of Collins Radio Company





"Soft" mounting will get your project off the ground more reliably

Here are the hard facts:

■ **Soft mounting**—or the use of engineered protective suspensions—is the preferred method for boosting the reliability of aerospace equipment.

As applied by experienced Lord engineers, this technique provides an optimized system for protection against severe vibration/shock/seismic disturbances. Here's why:

Soft mounting reduces the effects of dynamic disturbances to safe, predictable levels. Isolation efficiencies are compatible with equipment response characteristics.

Soft mounting can provide the performance variability to control low, high or broad frequency vibration plus shock.

Soft mounting avoids direct attachment of the equipment to the structure

where vibration levels are often an unknown factor.

Soft mounting involves damping and slacking in a engineered package compatible with tight-space constraints.

Soft mounting aids the control of load or unforeseen resonant responses, avoiding damage or equipment malfunction.

Soft mounting offers cost and weight savings compared to rigidization. "Boiling up" is avoided and lighter components can be used.

Soft mounting provides protection for storage, transport or in-flight environments.

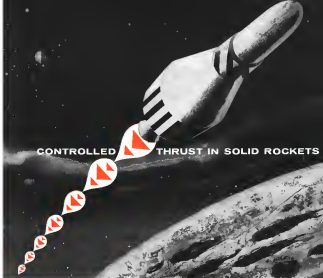
Soft mounting has increased the reliability of equipment for such projects as Atlas, Titan, Polaris, Block, Castor, Minuteman, Mercury, low-level B-52, X-15 and others.

Lord offers aerospace designers proved capabilities in the design, production and testing of soft mounting systems. A call to the nearest Lord Field Engineering Office or the Home Office, Erie, Pa., will put you in touch with the specialists in vibration/shock/seismic control.



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- **These and other capabilities . . . all with the inherent simplicity and reliability of the solid propellant rocket motor.**

- **How has AMCEL achieved thrust control in solids?** Through grain design . . . Propellant development. Creative engineering . . . demonstrating AMCEL's ability to marshal its assets — marked scientific capabilities and advanced engineering techniques — to provide swift, practical answers fulfilling the demanding requirements of the Space Age.

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EDITORIAL

Supersonic Transport Progress

It appears that the supersonic transport race is slowly moving out of the talking stage into a period where some firm decisions on its development are being made and some design issues and program matters are being worked to support it. All of this is transpiring despite the tests ordered against supersonic transport development by Sir William Hildred at the International Air Transport Association annual meeting in Sydney, Australia last month. It appears that five governments advise, tend and control in the air transport industry, he, Sir William, will be engaged both in the technical area of the supersonic transport and in the economic area of fare structures.

In the United States, SRI studies will soon be channeled into orders to begin the task of filling the key gaps in the current state of the art necessary for the development of an economically feasible Mach 3 transport (AV Nov. 6, p. 48). This effort also has been bolstered by two other recent actions:

- USAF-Potential Aviation Agency management agreement that utilizes the extensive technical management resources of the Aeronautical Systems Division of the Air Force Systems Command at Wright-Patterson AFB, headed by Maj. Gen. Arthur Davis.

- Creation of a special aeronautical research division headed by John Stock in National Aeronautics and Space Administration headquarters with five supersonic transport programs as a major part of its effort.

European Cooperative Effort

In Europe the shape of the supersonic transport effort is becoming clearer as the culmination of the British Aircraft Corporation-Vickers agreement (AV Nov. 6, p. 48) for a cooperative effort on a Mach 2.2 transport. Whether this agreement will be expanded further into the European consortium envisioned by Lord Vickers president, Georges Herold, as his Alfred Plesner Memorial lecture (AV Oct. 2, p. 48) is not yet clear. But it is certainly still a definite possibility.

The third entry in the supersonic competition is, of course, the Soviet Union where about all that is known of their effort is that it is definitely under way and apparently involves a basic new design rather than cobbling up an existing military design. Since the supersonic transport will depend extensively on international cooperation for its ultimate success, it is likely how much effort the Soviets are doing in bringing this design up to the standards of international airline operation after their failure to do so with their current jet and turboprop transport stable. It must have been a better disappointment for the Soviets to see their once-pioneering export drive with the Mi-6, An-10 and Mi-6 helicopters fade so fast and find that even Soviet satellites such as the Poles and Yugoslavs prefer British and U.S. transports. The

purchase of British Vickers and VC 10s by the Chinese is a remarkable diplomatic slap at the Soviet aircraft designers as well as a useful recognition of technical realities.

Another portion of Georges Herold's plan for Western transport development seems destined to remain on the drawing boards if the international airline is never attained. This is the dream of the market between a European Mach 2.2 service, available in the 1968-70 period and basically a 2,000-2,500 mi. range aircraft, and the U.S. Mach 3-plus transport, probably not available before 1972-75 and definitely a long-range transatlantic machine.

Difference of Opinion

The British have been apprehensive over backing anything beyond the Mach 2 range, while in this country we have been equally determined that the game is not worth the candle unless the end result will be in the Mach 3-plus speed range. There is no doubt that the technical fears raised by the British over Mach 3 have some grounds and represent genuine problems that must be solved. However, it may well be that the lack of British flight experience in the speed ranges beyond Mach 2 has led to their magnification of these problems into insurmountable obstacles in the manner that the so-called "noise wall" was hyped in the mid-fifties before any body had any real experience with its phenomena. The British jet men are seeking their Bristol T188 research aircraft to explore the flight ranges from Mach 2 onward, and with an engine left eventually hope to reach Mach 3 with this aircraft. In contrast, the North American X-15 has been providing a steady flow of flight data up to Mach 6 and temperatures to 1,000° while operational flight experience on the Mach 2 has been largely extensive by USAF and Navy fighters and bombers in service.

There are certainly formidable technical obstacles that must still be transcended to produce an economically sound Mach 3-plus transport and the U.S. effort is now more concentrated on research in these last problem areas. It may well be as Georges Herold suggests, that there will be ample room for both in the supersonic transport market. At one time we think the present U.S. development course is sound. Although it may prove more expensive and take longer than the current selected projects, our product for the ultimate goal will be reached successfully.

We also predict that, despite the due paucities of data by Sir William Hildred and his ilk, the supersonic transport will arrive on the international airline scene and when it does will prove beneficial to both the operators and the people of the world who are their customers.

—Robert Hitz



HERE'S HOW IT SOLVES SPACE COMMAND/GUIDANCE PROBLEMS



1. Command System Ground Checkout Equipment for Jet Propulsion Laboratory, California Institute of Technology, to test Ranger 3-2 NASA lunar probe.
2. Solid State FM/FM Telemetry Transmitters operated in Mercury spacecraft flights.
3. Flight Data Encoder uses high/low-level PCM telemetry system with $\pm 0.5\%$ accuracy, nullified out drift. A similar 70-channel system has been supplied to Jet Propulsion Laboratory for Mariner A.
4. Solid State LMF Beacon Transponder made possible precise tracking by MIT Lincoln Laboratories Military radar.
5. Digital flight controller/programmer in Douglas Aircraft's Delta Launch vehicle helped orbit NASA weather satellites Titan II and III, communication satellite Echo I, space probe Explorer X and XII.
6. 3-Channel Parametric Amplifier—Low noise operation for Q-Band microwave satellite tracker for Bell Telephone Laboratories.
7. Digital Command Decoder for Ranger 3-5 lunar probe.



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WHO'S WHERE

In the Front Office

Thomas H. Quayle, corporate vice president, commercial and industrial projects, Northrup Corp., Beverly Hills, Calif. (James J. Ward succeeds Mr. Quayle as vice president and manager of the company's Northrup Division, Systems Support Department, Anaheim, Calif.)

S. D. Rose, president and board chairman, S. D. Rose Corp., Los Angeles, Calif., a division of United Industrial Corp. Dr. Henry K. Muldoon, board chairman, Wilco-Kalor Inc., Long Island City, N.Y., and George Wallis, president, Dr. Henry Wallis Company, is member vice president of the company.

Earl L. Johnson, vice president, Division Director, division of Space Management Corp., Los Angeles, Calif.

C. E. Frost, vice president manufacturing and quality control, vice president engineering, Edo Corp., College Point, N.Y. (Ed J. Wondra succeeds Mr. Frost as Edo's chief engineer-electronics)

Melvin F. Rothrock, vice president of Dynalene Corp., Washington, D.C. (Edward J. Donohue, succeeding W. W. Bradstock, resigned)

Dr. S. Dean Wadwa, president, Packard Bell Computer Corp., Los Angeles, Calif. Dr. Wadwa continues as group vice president Defense and Industrial Corp., Packard Bell Electronics Corp. (Natalie vice group vice president of Packard Bell Computer Corp., Kenneth R. Johnson for administration, William Soden for manufacturing, Theodore J. Smith for marketing)

A. V. Grogan, vice president and general manager, Incostruc Electronics Corp., San Diego, Calif., a subsidiary of Incostruc Engineering Corp., and David T. Smith, vice president

A. K. Ashmore, controller, Vacuum Associates, Palo Alto, Calif., succeeding W. H. Chaudry, vice general corporate manager. Van B. West, vice president industrial division, Sperry Gyroscopic Co., division of Sperry Rand Corp., Great Neck, N.Y. (General Hawley K. Gaudin, San Diego Co.'s Semiconductor Division, New York, Mass.)

Harry H. Gorman, deputy director of administration, Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Ala.

C. E. Pugh, E-3 special assistant to the Under Secretary for Transportation, Department of Commerce, Washington, D.C.

Honors and Elections

Frank E. Hagerty, president and director of Texas Instruments, Inc., has been elected president of the Institute of Radio Engineers for 1967 (succeeding Lloyd V. Berkus, president of the Institute, Research Center of the Southwest). Elected vice president, Radio M. Amos, followed director of Telecommunications, Radioelectronics at Telephonics, Fort Worth, Texas, representing aerospace industry. T. A. Sherris, president of Hunter Manufacturing Co. and research professor at the State University of Iowa, representing North America.

(Continued on page 108)

INDUSTRY OBSERVER

Major advance in electro-electronics, in the form of this electro-electronics capable of providing amplification, has been made by an East Coast aerospace manufacturer under Navy sponsorship. Details are expected to be revealed soon.

Navy will soon award a contract to Raytheon for development of prototype aids for the Police Star ballistic missile. Contract, expected to total about \$1.5 million, will cover development and fabrication of flight test quantities.

USAF and Navy have awarded several research contracts to determine what type of guide is best for light waves to provide line-of-sight as nuclear explosions. Types being investigated are electro-optical, photonic, photonic and electrophonic. When exposed to a flash, some would be more optically efficient because of electrical means and others nuclear, after being triggered by a photoflash.

Basic type of primary fuel cell under consideration by NASA to launch Apollo power requirement is expected to supply an average of two kilowatts during a 14-day mission for a three-ton crew, or about 645 watts per man. This is more than two and a half times that projected by the Air Force about four years ago for missions spanning Man-in-Space/Man-in-Space/Sophisticated, and lunar reconnaissance. The basic type of cell, using hydrogen and oxygen, is being developed by Pratt & Whitney Division of United Aircraft Corp.

Navy Hydrographic Office has asked industry for proposals for 185 sets of "instrument sets" as part of the national oceanographic program to supply information for anti-submarine warfare projects. Sets would be developed and tested in eleven types of Navy and merchant craft. They would contain units consisting of, hydrographic, meteorological, oceanographic, and navigation systems for measuring surface and air temperature, wind speed and direction, incident and reflected solar radiation, and more waves and navigation.

Bendix Corp. is studying acquisition of acoustic track of decoy enemy bodies to simulate more accurately the nonstation signals produced by the actual re-entraining vehicle.

First hardware test for Nike Zeus anti-missile modules of the system is approved for operational development will be in the New York area. Other tests are successfully planned for the Washington-Baltimore area, Los Angeles and the Midwest indicating that population centers rather than military bases will get priority in protection. Site design is progressing with the development of the system.

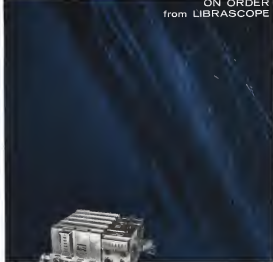
General study of radar cross-section measurements relating to re-entrance body penetration techniques is being performed by Air Force Research Laboratories, Inc. Research aimed at solving radar cross-sections of re-entrance vehicles is being done by Chrysler Corp.

Actual flight tests to obtain precise estimate of an instrument's blood pressure during spaceflight is under development in North American Aviation's Space and Information Systems Division.

Stanford University's electronics laboratory and Planning Research Corp. of Los Angeles are analyzing reconnaissance techniques for Air Force in connection with the Soviet satellite program.

Texas Instruments for Delta Star heat shield flights will be monitored by an automatic clearance detection system that will trigger the abort operation in case of a malfunction. DeltaStar 12 sec duration 40,000 ft (first solid rocket motor model) should weigh 72,000-lb. second stage to approximately 83,000 lb. at Mach 9.4. Glide flight tests of the DeltaStar has a 3-2 hour drop will involve firing of the escape rocket in start and acceleration to supersonic speed. The glide test will be able to land at sea, against wind currents of 8,000 ft. in height.

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Washington Roundup

Military Space Beat

Proper role of the military services in the national space program continues to be the hottest question when policy makers get together. "Twopen on hot at the second Air Force Scientific Advisory Board meeting, where each service, National Aeronautics and Space Administration and Defense Department civilian officials exchanged views on space."

Air Force insisted that the present Pentagon policy of acquiring a satellite before a space development is undertaken was too restrictive; Navy said no one service is wide enough to handle all the possible military applications in space; and a Defense research and engineering noncommittee criticized both Air Force and Defense management and what he called USAF's "not rounded bent" attitude. He praised NASA's "healthy and vigorous" program, and said Air Force might take some management lessons from it. The roundtable brought a strong counterattack from a broad audience.

All this will erupt in public if the House space committee goes ahead with plans to hold hearings on the military's role in space. Staff members have been interviewing service leaders and NASA officials. Chairman George P. Miller feels at the moment that the services have enough authority in space now and he is pleased with NASA's operation.

Patent Picture

President Kennedy apparently favors a sweeping new patent policy that will be proposed in law by Sen. Russell Long and Sen. John McClellan in January. It is the so-called "origins" plan—if the government provides all the research and development funds on a project, it should enjoy all the royalties on all inventions patented, if the financing is split 50-50, royalties should be similarly split. Hearings on the proposed law will be held in January. It is supported by Lee Lieberman, assistant attorney general and head of Justice Department's Anti-trust Division. The President is expected to take executive action even before Congress completes work on the bill.

House space subcommittee hearings on NASA's patent policy now have been postponed from Dec. 4-7 until sometime next year because of conflicting schedules and the staff's desire to do more research.

Defense Department, meanwhile, has declined to aerospace companies a number of proposed patent revisions that would make further claims on industry's current rights. There's a mild proclivity intra-government "competition" such as Defense offering contractors better patent terms than NASA or Atomic Energy Commission, and would permit Defense to license patents to foreign firms. Industry executives are due on Dec. 1.

Soviet Boosters

U.S. experts who have studied data submitted by Russia to document its claims to four world's records for Mig Gherman Titov's space flight (see p. 20) think the launch vehicle probably consisted of two stages. First stage thrust probably was about 1 million lb and second stage thrust about 500,000 lb. The 10,470-lb weight of the Vostok payload is considered too light to require a three-stage vehicle but too heavy for a single stage vehicle having the impulse of thrust indicated by the Russians.

S. Wesley Reynolds, security director, and Maurice H. Kline, personnel director of the National Security Agency, resigned last week at the government's request. Both came to public notice last year after two major military mistakes at the highly sensitive defense communications agency, defected to Soviet Russia. Portuguese spokesmen and neither firing is directly related to the defections.

Reynolds' firing was based on Section 10 of Defense Department's new "standards of conduct" directive, which concerns acceptance of any bribe or gratuity that might affect or attempt to affect the efficiency of a government employee. Kline's case, which has been referred to the Justice Department, was related to findings revealed last year that there were discrepancies in his own personal records, according to the House Un-American Activities Committee.

Golovin Windup

The Defense-NASA Long Launch Vehicle Group (Golovin Committee) was called back into day and night sessions last week to incorporate into its report recommendations made by top officials of both agencies, but that is not expected to change the report proposal—use of the Saturn C-4 vehicle and the rendezvous technique for the lunar landing mission (AW Nov. 6, p. 20).

Successful Nike Zeus test shots (see p. 29) and the great effort of Korea to make the world believe it already has an anti-ballistic missile (see p. 21) are expected to push Defense Department into ordering aerial producers of Zeus test rest, even though Secretary Robert McNamara and 10 dems say that the question was still under careful review.

Maj. Gen. August Schochberg, commander of Army's Ordnance Missile Council, began his recent briefing to the Air Force Scientific Advisory Board (see above) by pointing to a shot box and saying: "This is the Army's space program." Then he opened the box to show that it was empty.

—Washington Staff

S-1 Award Puts Chrysler in Space Field

Auto firm wins major competition for Saturn booster; dollar volume may exceed work on Redstone, Jupiter.

By Edward H. Kolesar

Washington—Automobile industry has made its first major entry into the space field with the award of a contract to Chrysler Corp. to build, check out, test and launch the Saturn S-1 booster—an assignment that is expected to grow into systems integration and management for the entire Saturn C-1 vehicle.

First contract calls for production of 20 S-1 booster stages at National Aeronautics and Space Administration's Michoud, La., plant at an estimated cost of \$200 million. The contract, however, could easily surpass the \$750 million Chrysler's Missile Division received from the Army for producing the Redstone and Jupiter rockets.

Aircraft General Corp., which bid as a subcontractor for the service issues in the same package, including Chrysler's, will assist in static testing and launching.

Product Improvement

Used pattern for missiles and space vehicles in the past has been in single systems assignments to the first contractor, and Chrysler is expected to assume this task as the C-1 vehicle also comes operational. The contract also calls for product improvement.

The Saturn S-1 stage consists of a cluster of eight Redstone-like engines known as H-1 engines each of which develops 110,000 lb. thrust. NASA's Marshall Space Flight Center is manufacturing the first 11 boosters, 18 of which are flight tests. A highly successful test flight now was conducted Oct. 27 (AW Nov. 6, p. 90).

As now conceived, the C-1 will be used to send objects to the moon via a two-stage stage added which carries Earth reentry. Contract for the S-IV second stage, which is powered by six Pratt & Whitney J-2 liquid-fueled engines, is held by Douglas Aircraft Co. The Cosine S-V third stage is powered by two RL-10 engines.

Chrysler's Saturn effort will be headed by James C. Smith, Jr., now director of the Defense Projects Organization in the Defense Group, and the company will establish a new Space Division to manage the project. Members of the team will go to Marshall and Michoud before Jan. 1. In next few months, 1,500 Chrysler employees will be assigned to Michoud and the number is expected to reach 2,400 by early 1969. Production goal has been aimed at one vehicle per month beginning late in 1968.

The Saturn S-1 contract is the first in which an automobile company has won a major space contract in competition with established aerospace firms.

pany. The Jupiter and Redstone contracts were negotiated.

Aside from the fiscal proposal, other items were considered at the advice of Chrysler officials.

- Current Administration strategy of broadening its industrial base (AW June 5, p. 25). Strong bids made by Chrysler and Ford Motors Co. (AW Sept. 15, p. 30) indicated they were encouraged by this attitude enough to complete agreements after the aerospace companies (AW Nov. 13, p. 30).
- Management team is confident, developed by Redstone and Jupiter programs, but new vehicle work, Redstone production line closed in January, and the Jupiter line shut six months later.
- Long association with the Marshall team known by the name of the Saturn when the contract was a part of the Apollo-Minuteman Agreement, and later in the

• Long association with the Marshall team known by the name of the Saturn when the contract was a part of the Apollo-Minuteman Agreement, and later in the

NASA Contracts

Washington—National Aeronautics and Space Administration expects to award two more substantial contracts (see story) and to decide on expanding the contract Jupiter-Minuteman contract with McDonnell Douglas Corp. within the next three weeks.

Source selection board is now in action at the Marshall Space Flight Center, Huntsville, Ala., on the S-1B bids, and expects to forward its recommendations to the board. The board meets each next month. The board recommendation on Project Apollo bids last week went to Richard E. Holman, Marshall Space Flight Program Associate. Final decision may be made on both bids by Dec. 15.

Headquarters decision on extending the McDonnell Douglas contract to a Mark II Project Minuteman capsule has been pending for some weeks (AW Oct. 30, p. 21). Funds are available but the project for a reusable, 14-day orbital mission has not yet been approved.

Saturn project. Chrysler has done a large number of engineering support tasks for Marshall on the Saturn project. Chrysler was the only S-1 bidder with experience in building and launching large liquid-fueled rockets. Other companies for the contract were Avco Corp., Boeing Co., Ford Motors Co., Aerojet-General, Chrysler, Chrysler, Chrysler, and Lockheed Missile and Space Co.

Although Chrysler's plant in its own commercial test facilities in Detroit for component checkout, NASA will launch the Michoud production site and a static test facility at Ford Research Plant. NASA will provide testing for Michoud and other transportation of booster from Michoud to Ford Research and the Atlantic Range Range in Florida.

Chrysler accepted the Michoud facility as a temporary plant during the Saturn S-1 program.

Space Flight Steps

Chrysler will spend the Michoud plant with the mission of the Saturn S-1B contract, which is a static test condition by a source selection board at Marshall. The S-1B is expected to use two 1.5 million lb. thrust Rocketdyne F-1 engines and be the booster stage for the Saturn C-1 vehicle (AW Nov. 6, p. 20). A development contract is pending for the plant.

Bidders for this booster are: Aerojet Rocket, General Dynamics/Aerojet, Martin Co. and Space Technology Laboratories Inc.

Major items of government hardware are in the S-1 contract are the H-1 engines, command system, deorbit and return vehicles.

During its machine development and fabrication program, Marshall has established a list of "process" vendors for the S-1, which will be awarded once Chrysler has partly selected other sources from reliability, cost and timing standards.

More items already under contract from vendors, selected for the next part in competitive bidding, are: tanks, nozzles, packaging, service ducts, the upper burner section, heat exchangers and the tail shield.

Part Chrysler Saturn vehicle, designated SA-111, will be used to fly a half-scale Apollo prototype vehicle. The second vehicle will launch the same mission and the third will be scheduled to qualify the Apollo re-entry module.

Arrangements for the remainder of the Chrysler Saturn vehicles are on the schedule for the Apollo test and flight flights of the Nova nuclear rocket. Nova propulsion vehicles are scheduled for Chrysler vehicles 8, 9, 11 and 12.

NATO VISTOL Transport Proposals Due

Five-to-six dozen contractors or companies, some of them with multiple proposals and teams, were expected to submit formal proposals last week to meet the deadline for bids to the North Atlantic Treaty Organization's Basic Military Requirement 4 competition for a medium-range VISTOL transport.

Although NATO officials had anticipated originally that the proposals in this initial phase would be more along the line of statements of capabilities, a number of firms are submitting detailed design specifications on one or more approaches. The top five designs will be chosen for further study before a final decision is made. Proposals also are being prepared for NATO VISTOL, single fighter design competition (p. 20).

Proposals for the VISTOL transport have been sent to two general categories—aircraft and helicopter—with the intention being to consider both.

- Long-Term-Vistol: In a competition with Fuchs's Sea Scout, Italy's Fiat and possible Dornier of Germany. The design is essentially built around the following aircraft that has been selected in the U.S. as the baseline VISTOL transport (AW Sept. 25, p. 51). Proposals are also General Electric T64 transport engine, Long-Term-Vistol's U.S. associates in the program are Lockheed and Hiller Aircraft Corp., also are participating in the NATO competition too.
- Douglas Aircraft Co., with Sea Scout, in a potential partnership with Fuchs's Sea Scout. The design is based upon Douglas' entry in the previous competition.
- British Aerospace Group with several designs including both the helicopter and the helicopter prototype. Proposals, combined

by a unit known as the Advanced Projects Group with approximately 100 engineers, includes a MA-1 version of the British Conquest helicopter transport, a second STOL, incorporating T64 helicopter plus 30 engines, a version of the Armstrong Whitworth 501, using Bristol Siddeley BS515 lift thrust engines (AW Sept. 22, p. 41), and an entry designed by the de Havilland 121.

- Kaeli Aircraft Corp. with a solid-state version of its BS-1, powered BAC 205 in partnership with Italy's Mosca, Aeritalia, Aeritalia, Aeritalia and possibly Dornier (AW Nov. 13, p. 31).
- Short Brothers & Harland with an STOL version of its 301 jet transport using Rolls-Royce RB 163 engines to set in initial lift (AW Nov. 6, p. 65).
- Hawker Pigeon with an STOL version of the Bristol transport incorporating General Electric T64 powerplants.
- The de Havilland 121 of Canada with one proposal for a NATO version of the Conquest.
- Fuchs's Request with an aircraft based upon the more wing concept of its VISTOL transport.
- Italy's Aeritalia with a new design based upon one of T64 in both push and pull configurations.
- Dornier with an initial design concept incorporating British Siddeley T64 engines pushed towards the wing.
- Fuchs-Wall with a VISTOL, built around RB 163 in a single push plus a BS-1 and an STOL, similar utilizing the T64 helicopter and RB 163 for lift. Potential partners within West Germany are Henschel Flugzeugbau and West Flugzeugbau.

Soviet Union Claims 100-Megaton Warhead; Emphasizes Anti-Missile

Washington—Soviet official leaders claimed that the Soviet Union has only 50 to 60 megaton warheads of TNT, but that it is capable of producing and testing of ten-to-twenty nuclear explosions in the next Soviet test series expected Oct. 30 and is estimated to have an equivalent yield of between 37 and 60 megaton tons of TNT.

Ramsey also charged that U.S. leaders for saying the point of Soviet Defense Minister Kirill A. Moskalov said that Russia has an effective missile defense system in his speech to the 22nd Communist Party Congress.

In a Moscow radio broadcast, the conservative and Moskalov "said a devoted tribute to Soviet test series, which are devoted all means of defense of atomic weapons that he can. In other words, there is an anti-missile defense system."

Soviet newspapers printed the anti-missile missile claim along with anti-missile claims that Moscow and other major Soviet Union cities have nuclear and anti-air defense and networks of lightening fire.

Defense Department sources said the Soviets have the better capability to launch an intercontinental ballistic mis-

sile with a multi-megaton warhead, possibly one with a yield in high 50 megaton tons. These sources are in large part based on the Soviet Union's own claims to quantify production and testing of ten-to-twenty nuclear explosions, these sources said.

In response to U.S. reports that the Soviet Union has only 50 to 60 megaton warheads, U.S. officials, including the U.S. State Dept., said that the Soviet Union has only 50 to 60 megaton warheads.

"We have ready-made powerful nuclear weapons and their number is constantly growing," they announced in Moscow yesterday. "We have ready-made powerful nuclear weapons and their number is constantly growing," they announced in Moscow yesterday.

According to Col. General A. N. Ponomarev, of the Technical Service, Soviet leaders are equipped with anti-missile missiles, which are capable of destroying the Soviet Union's missile force (AW July 27, p. 30). The leaders said that the anti-missile defense system is a target for launching, he said.

From the Navy Headquarters, Eugene Adm. N. V. Shchegolev said that the

anti-missile of the Soviet submarine fleet is nuclear powered submarines whose range and endurance when submerged are practically unlimited. He also said that the Soviet Navy has recently with target-sinking nuclear capable of striking enemy ships, particularly aircraft carriers, hundreds of kilometers away.

BAC Agreements

London—British Aircraft Corp. has announced a series of agreements with four European firms last week concerning transatlantic aircraft production and possible additional planning for cooperation in the North Atlantic Treaty Organization competition for a VISTOL, strike reconnaissance fighter and a supporting medium-range transport.

BAC and its partners have been awarded with Sea Scout for the competition on creating and long-term commercial projects, including an agreement whereby the French firm will manufacture the tail planes for the VISTOL jet transport as provided by Aviation Week Nov. 6, p. 40.

In other terms, BAC will enter into partnership with Marshall Dornier in submitting a version of the Vistol 205 as the NATO strike fighter competition (p. 21) and with Italy's Aeritalia, Aeritalia, Aeritalia and possibly Dornier (AW Nov. 13, p. 31).

Defense Deliberates Funding of MRBM

Proponents bidden for development of an Air Force missile stage ballistics missile for NATO request a request for proposals to be sent out even though the decision on whether to fund the project still is being deliberated at top Defense Department level.

One complicating factor is the decision-making process in the Army's lack of enthusiasm for the program. There does not seem to be an objection to the mobile MRBM concept but probably to the fact that the missile would cost into the higher range capability of the Army's Forward Airborne Defense missile at the lower end of the MRBM range span. If the program is implemented, industry observers feel that it likely the Army might be given responsibility over the development of the missile aspects of the weapon system.

Missile Requirement

Requirements for the missile probably will specify a range of 1,000 to 2,000 miles solid propellant configurations for operation over a range of 100 to 2,000 miles. Short ranges in the operational span would be accomplished with dual propellant systems. Stable, longer range solid propellant also were considered, but were not adopted for the program phase.

Reaction time demanded for the operational MRBM system probably will be

less than 5 min. In addition to range and reaction time, specific requirements in the test statement may be directed at guidance and mobility capability, terminal length and diameter, which would not exceed 48 in. This would be a small grain propellant compared with diameters of 120 in., 24 in. and now projected for the mobility, spawning large solid-propellant program, and could be handled in shore-based units.

The MRBM solid-propellant requirement was not seen as precluding the status or schedule of the large solid booster program. Otherwise, leaders will have considerable latitude but will stay within the state of the art, because weapon development would be directed to achieve operational status with a low price.

Increase in propellant specific impulse would be desirable but is not likely to exceed presently available of approx. 240 sec. Substantially higher specific impulses only could be obtained but there likely would be research communities rather than the stable compounds which would be required to meet the range of track requirements over rough seas.

Method of third vector control, likely to be incorporated in both missile stages, almost certainly will be left as an open item. It will probably be considered a variety of schemes proposed by vendor bid.

Early Calculations

Initial program for the system envisioned a missile weighing approximately 12,000 lb, plus about 16,000 lb for the transporter. Douga trials may allow time delays to increase to as high as 26,000 lb for the truck and 13,500 lb for the transporter.

Whether the program will be linked off as a feasibility study or for development of prototype hardware will depend on the amount of financial support in one event, about \$10 million is expected to be allotted out of fiscal 1967 funds, if the program is implemented in this fiscal period. Development probably will be on the basis of needs for airframe, engines, and propulsion to contractors of aerospace units instead of repeating overall requirements in a single prime contractor. Aerospace Corp. would supply general contract engineering and technical direction (AW Nov. 4, p. 21).

Question of implementation of the program is opened by reports that the Soviet Union has developed two missiles in this category, having ranges to 700 and 1,100 nautical miles, using liquid propellants—probably RP-1 type fuel

Both systems are mobile. Similar numbers of these missiles are expected to be deployed over a period of two years. Reaction time of these mobile weapons would be substantially longer than that required for a solid-propellant MRBM.

One of the arguments against implementation of MRBM is that the development would be solely for NATO, since the U. S. doesn't need the weapon for its own defense arsenal. The mobile version of the Minuteman ICBM, which is under limited development, may be accelerated early next year.

Political factors are favorable for development of the MRBM for deployment in the NATO countries, which would operate the weapon. Only consideration which might be subject to negotiation would be responsibility for the missile launch. France and West Germany probably would be the main European users.

Limitations Discussed

One of the aspects of system feasibility undoubtedly has been concerned with effective sea-based, considering developments which may be required by narrow seas, roads, and bridges. These may be encountered in countryside areas of some highland states.

Those same considerations would apply if the weapon was staged for deployment in the U. S. The mobile launcher seen in the opportunity for adaptation of the system, considered to be substantially greater than in the case of fixed launchers.

The MRBM conceivably is a refinement of the Air Force's small ICBM which was proposed under A-5, 19752 IAW Jan. 16, 1960, p. 20, with heavily smaller command and control and other technical requirements. Probably only range requirements will be the key change to meet particular deployment demands. Both the MRBM and its predecessor concept,

West Ford Theory

New theory which holds that Project West Ford type elements would acquire an electric charge in orbit, producing electromagnetic fields that would cause fluorescent objects to glow, or approximately 1,000 mi. per sec, has been advanced by Paul B. Singer of the University of Maryland. This is in addition to the belief that that would result from positive or negative charges in the elements. Singer has taken a step to have at least one element to test in a controlled test space station for Project Laboratory in Pasadena, Calif.

The small ICBM system, represent the broad thinking of Space Station Division's Col. N. M. Lohrey and his group, which plans and reviews all related activities for both Space Station Division and its component Ballistic Missile Division under AFSC's Dept. 3, Communications for Aerospace Systems, Arlington, Calif.

Concept Genesis

Mobile ballistics missile concept which MRBM now is at least four years old. Gen. Frank E. Everett (ret.) favors immediately. The first concept, in conflict with existing the idea for this type of weapon, which known as the mobile ICBM, for European deployment, which he met USAF officials in 1957 to 1959.

USAF May Request 120-in.-dia. Solid Propellant Proposals Dec. 1

Request for proposals, proposals for the 120 in.-dia. solid-propellant propellant systems, may be submitted as early as Dec. 1.

Aerospace Corp. currently is preparing a work statement to cover mobile development and establishing a program for its special vehicle engineering and technical studies, in accordance with Air Force instructions.

Initial funding for some development in 1967 probably will not exceed \$25 million, according to industry estimates.

Development of the 150-in.-dia. missile, previously considered likely as a companion project with the 120-in.-dia. missile, will not be implemented for the present but can be planned into the program later.

The 120 in. missile would be delivered to The Marine Co. as government furnished equipment for use with the TH-1H (Hawkeye) with two 150-in.-dia. missiles attached to the base of the first stage of the vehicle, as formed as a booster for the Dauntless glide vehicle.

Other uses possible for the system include the Air Force's Phoenix program, the Army's Advanced Communications Vehicle, now reported to be considerably heavier than original proposals and far more of the mission suggested by the Air-Sea-Corridor vehicle. Meanwhile, propellant reduction would be required, with 150-in.-dia. missiles now for development with support of the 120 in. missile, using existing facilities.

United Technology Corp. was negotiating with Edwards AFB, Calif., to conduct three flights for about \$2 million. These would include two three-stage 16-in.-dia. missiles and a 120 in.-dia. missile to be fired later in the

Space Technology Laboratories, as technical adviser to the former Air Research and Development Command's Ballistic Missile Division, studied the detailed aspects of the mobile MRBM and these studies were continued and extended by Aerospace Corp. when it succeeded Space Technology Laboratories in its complementation technical role to the Air Force.

Later last month, Aerospace Corp. already had discussed the total requirements of MRBM with both propellant and vehicle contractors.

AFSC's Maj. Gen. Maxine G. Gough, chief of staff for systems, will lead the MRBM effort if it is implemented. Working under him will be Col. M. A. Cristofani, Col. T. K. Hebertson, and Maj. R. Rosenthal.

program. United Technology, continues the firm, and also discuss each as solid propellant.

Aerospace General staff, conducting negotiations with Edwards on Nov. 16, had applied research in large, various means, perching a five-stage, 160-in.-dia. missile, and two 120-in.-dia. missiles, for the 120-in.-dia. missile. Aircraft considers each end cap a segment.

Lockheed Propulsion Co. on Nov. 17 reported to be a two-stage 120-in.-dia. missile. Space Technology also considers each end cap as a half segment. The configuration would consist of a single outer segment and two end caps. Lockheed studies for third vector control. But segment, probably, would require, from its own inert gas, and also nitrogen, to supply additional thrust of the exhaust nose backward.

Thiokol Chemical Corp. also was scheduled to submit proposals to Edwards for large solid-propellant missile applied research.

Because the Air Force attaches top importance to the development of the 120-in.-dia. solid-propellant missile, it's likely that the program will be headed by a newly appointed brigadier general in the Air Force Systems Command's Space Systems Division under the deputy commander. Air commander, interim, will be Col. Langdon A. Jones, in charge of missile development, and Col. Rosenthal, Harrogate for the vehicle.

Col. David Carter would manage the program for AFSC, under Col. Rosenthal, Northridge.

Department of Defense, effect in the program in the responsibility of John H. Raski, deputy director of defense research and engineering.



Minuteman Success

USAF Boeing, Minuteman, solid-propellant, short-range, ballistic missile was successfully fired Nov. 17 from an underground site at Cape Canaveral, Fla. First attempted firing, from a site where the missile exploded after leaving the tube (AW Sept. 10, p. 61). The Nov. 17 shot traveled more than 1,000 mi. Only rocket was a minor one. A dose in the site will likely be close to 100 mi., allowing equipment to be easily recovered.



FBV-2NE Now in Production for Fleet

Newest version of the Navy-Corbin Vought fighter-FBV-2NE—is now in production at Long-Tecno-Vought's Dallas, Tex., plant under a \$14-million Navy contract. Aircraft will arrive in production through 1961 under general contracts. The 2NE is powered by Pratt & Whitney J77-B2 turbojet engines. Longer take-off provides increased target acquisition and tracking capability (AVF Aug 12, p. 231).

Advanced Nuclear Reactors Planned

New York-Powhatan program to develop reactor systems with higher power densities than current K-1 type will be the next step in nuclear rocket development for space flight, Harold B. Fieger said here last week.

Fieger, director of nuclear systems for National Aeronautics and Space Administration, led a meeting of the Nuclear Energy Water Area, that there were further proposals for both positive and negative reactor system study at the trip. Several Bluebirds, he added, there is much work that remains between now and then.

Typical example he cited was the necessity to build and test between 50 and 60 complete power sections before first flight test of a Nuclear rocket engine now scheduled for sometime in 1960 or 1967. All of these test reactors will have reactor capability, and all will be run through several separate test regimes.

Current thinking is to design the Navy stage for Multi (Reactor In-flight Test) as if it were to be the third stage of the nuclear Nova or Saturn C-4 as it is now called. But this would depend on the true status of all projects involved and on a decision to use Saturn for the lunar mission.

NASA now feels that orbital rendezvous will best be accomplished with only two stages to zero, rather than the multi-stage assembly jobs that have been suggested. Fieger said that could be done by using the first two chemical stages of the Saturn C-4 as booster. Two of these would be needed for each mission. One of these would carry the third (liquid) stage of the chemical Nova system and the other would carry the fourth (thrust loading) and fifth (thrust to orbit) stages of the chemical Nova. Rendezvous in orbit of these two payloads would re-

sult in a fully loaded, three-stage system ready to go on a rendezvous mission and return.

Such a system would be all about 100 tons. Fieger believes any more loading program must rely on chemical propulsion if it is to meet the Apollo program deadline of "before the decade". But he also believes other nuclear stages must be developed in parallel so that if they come through in time, they can serve as alternate systems.

In another talk, NASA Administrator James Webb told the Manufacturing Chemistry Area, here that the lunar take-off system for Apollo requires less engine thrust than will result on the order of 25 tons. Other options place the total Apollo payload required at 193,000 lb., including escape system.

Three Powers Resume Nuclear Testing Talks

Soviet Union last week agreed to the U. S. 5-month proposal for continuation of negotiations on a nuclear test ban Nov. 18 in Geneva, but gave a strong indication it would again walk out if any Western power conducted tests.

The Soviet note stated that "in the case of the talks any power will own not only of nuclear weapons, then by force of circumstances... the other side will be compelled to draw the appropriate conclusion with regard to nuclear test." However, the U. S. indicated in a statement that it reserved the right to conduct tests if it felt there were accurate.

After walking out on the Geneva negotiations, the Soviet Union ended a three-year voluntary moratorium on nuclear testing Sept. 1 by setting off the first of a series of 17 test explosions, including one with a yield of more than 50 megatons. The U. S. conducted four underground tests between Sept. 15 and Oct. 28.

The Soviet agreement to resume test-

ing negotiations followed by one week the adoption by the United Nations political committee of resolutions outlawing the use of nuclear weapons in war and banning nuclear testing or developing on African territory. The two resolutions, supported by the Soviet Union and opposed by the U. S. and other Western powers, were approved by the UN General Assembly. The Western bloc charged "hypocrisy" as the Soviet position and noted that the resolutions provided no safeguards against nuclear war.

Meanwhile, two other phases of disarmament—prohibit use of outer space and general disarmament—were also scheduled in the UN over the issue of committee representation. The Soviet Union insisted on its "troika" plan for equal representation by Western, Communist and neutral blocs but the West refused to accept it.

Beech's 1961 Sales Down \$26.8 Million

Total sales of \$72,099,900 were reported for Fiscal 1961 by Beech Aircraft Corp., down from 1960's \$98,971,800 reflecting transition of the company's revenues from commercial aircraft and other aircraft of U. S. business concerns in the past year on commercial plane sales.

Approximately 62% of Beech sales in Fiscal 1961 was business aircraft, a total of \$45,009,950, and although sales were the previous year's \$46,170,254, represented a 31% gain over 1959. Military Fiscal 1961 sales totaled \$26,910,700, which the company and co-ordinated it rather previously for that period, but represented a sharp drop from 1960's \$52,323,546. Business aircraft report sales showed a 31% gain last year over 1960.

Net earnings after taxes and \$4,554,079 for Fiscal 1961, compared with \$4,354,079 for Fiscal 1960.

Ranger Probe Fails; Lunar Shot Still Set

Washington—Second attempt to place a Ranger probe into a highly elliptical orbit failed Nov. 15, but the National Aeronautics and Space Administration still plans to launch a Ranger lunar impact probe in January.

Ranger 2 went into a low earth orbit when the Agena-B engine failed to re-ignite after a coast period, the same failure which prevented Ranger 1 from completing its mission (AVF Aug. 28, p. 231). Ranger 1 and 2 were designed primarily to test attitude control, solar power and communications systems for lunar-landing Rangers in an orbit ranging from 17,000 mi. to 395,000 mi. Ranger 2 was injected into an orbit with a 145,700-mi. apogee, 94,500-mi. perigee and 83.5-min. period.

Dr. A. R. Hibbs, director of Jet Propulsion Laboratory's Space Sciences Division, and JPL most nuclear tests began before assuming the effort of the program in the latest program schedule but plans were proceeding to launch three Ranger hard lunar landing spacecraft in 1962. Ranger 3 will be launched in January, Ranger 4 in April and Ranger 5 in December under present schedule.

Dr. Hibbs left open the possibility that the Agena-B launch vehicle in the spacecraft may be re-activated. Ranger 3 and 2 payloads were identical, with chemical power systems designed for 90-day lifetimes. The remaining seven Rangers are designed for 60-day lifetimes, since they will impact on the moon. There is no backup for Rangers 3 and 2, Dr. Hibbs said it could take six months to a year to build another similar payload.

JPL has been forced to reduce the weight of its Marsden Venus payload from 1,160 to 150 lb. so that it can be flown on an Atlas Agena-B instead of a Centaur as originally planned. One alternative on Ranger which is under consideration is use of a Titan II as the launch vehicle.

The Lockheed Agena-B has been twice previously restricted three times in five attempts. Successes were Bioscience XVII on Aug. 5, Manned III on July 12, and Manned IV on Oct. 21. The failures have been on Rangers 1 and 2.

Ranger 2 was launched at 1:12 a.m. (EST) from the Atlantic Missile Range and the boost phase included engine cutoff 13.9 sec. after launch, sustainer cutoff at T plus 27.9 sec., and velocity cutoff at T plus 231.15 sec.

The Agena engine, scheduled to burn for 160 sec. against 354 sec. after launch and cutoff 149 sec. later. The program called for a 700 sec. coast period while the testing was in a 300 sec. parking orbit. The second burning cycle was to have lasted for 35 sec.



LIFT-OFF OF RANGER 2 elapsed orbit attitude occurred Nov. 15, but payload went into low earth orbit. Failure was caused by Agena-B engine which did not restart after a coasting period. The state failure prevented Ranger 1 from being completely successful. Ranger 2 was placed in orbit with an apogee at 395,000 mi. and a perigee of 97,000 mi.

'Serious Overstaffing' in Pentagon Slows Decisions, Jackson Charges

Washington — "Serious overstaffing" in the Defense Department and other federal agencies is causing sluggishness of decision and action, Sen. Henry Jackson (D-Wash.), chair man of the Senate Subcommittee on National Policy Machinery, charged in a statement marking the end of his group's two-year study.

"The use of the national security departments and agencies has swelled out of proportion even to the occasional number and complexity of our problems," Sen. Jackson declared. "Although the payroll cost is 'formidable,' the cost in inefficiency is even more on par with the cost."

"Unnecessary people make for an unnecessary lagging, unnecessary decisions and consequences, and unnecessary actions in the face of affairs working on problems of real importance. Many offices have swelled and passed the point where the quantity of staff reduces the quality of product," Sen. Jackson said.

"The fight against overstaffing must be waged each day," he said. "Dispositional savings of the personnel, accompanied by such drastic wage cuts as headlines that are being reduced."

Many recommendations of the Jackson subcommittee have been accepted by the Kennedy Administration. These include: faster guidelines from State Department on how the Defense Department can supplement foreign policy; more emphasis on reduced responsibility, availability of cabinet members; and less diffusion of authority through inter- and intra-departmental consultation, inclusion in the "paper and all decisions" activities of the National Security Council, the appointment of outside staff forces of experts to make recommendations to the White House and government departments on specific subjects.

Other highlights of Sen. Jackson's statement were:

- Redundant additions to our existing policy machinery are "unnecessary and undesirable." Proposals that could save strategic heads and thereby help the staff to advise the President, Sen. Jackson said, "violate sound administrative practice by seeking to interpose officials before the President and his key cabinet officials. They act on the mistaken assumption that the weaknesses of one organization can be cured by creating another."

- Heart of the problem "in getting our best people into the right places, policy and defense posts." More often than not,

Sen. Jackson said, poor decisions "are traceable not to machines but to people."

- State Department generally "attaches too little importance to looking ahead in foreign policy, and is too wedded to a philosophy of reacting to problems as they arise."

- Budget Bureau should be strengthened, not weakened—a position at odds with that taken by Sen. Stuart Symington (D-Ma.) and other congressional leaders, who have complained that the bureau has decided defense issues by fiscal actions. "The budgetary process is the President's most helpful tool in establishing . . . an order of national priorities and in seeing to it that the operating programs of the departments and agencies conform to these priorities," Sen. Jackson said.

Overtime Authorized For Space Workers

Washington—President Kennedy last week authorized the U.S. leadership in space to a "total national objective" and authorized the National Aeronautics and Space Administration to allow its laborers and mechanics to work overtime.

A NASA spokesman said this would allow a limited number of its employees some rest of their already were shifted to work overtime because of the high priority given space projects.

The president's executive order said "the utmost effort and assistance" be rationed of a closely leading role in aeronautical and space achievement by, because a total national objective.

News Digest

Paid Army Ballistic Missile Defense System (ABM) (B) development cost is estimated to go to a General Electric-Corbin team following a review by Dr. Harold Brown, director of defense research and engineering (ADP No. 20, p. 20). Phase I studies were conducted on the system by the contractors.

French civil aviation budget for 1967 includes \$2,400,000 for Space Research development. First production model of the man-in-space vehicle is expected to fly in 1969. Although no firm orders have yet been received, production plans call for 12 Super Hornets to be completed during 1967. First production version will fly

in December, 1967. Price of non-production version with two Turbomec Buzon turboprops is \$290,000. First production model will sell for \$320,000.

Marshall Space Flight Center will establish a financial management office Dec. 1 at Cocoa Beach, Fla., and a planning and contract office there Jan. 2. These offices will support National Aeronautics and Space Administration launch operations at the Atlantic Missile Range.

USAF Divisions XXXV was reactivated by a Lockheed JC-130 within 14 mi. of Tern Island Pacific Missile Range tracking station after launch Nov. 15 from Vandenberg AFB, Calif. Recovery was made Nov. 16 on the 17th after other than on the 17th as planned (AW Nov. 26, p. 31).

Members of Sen. Scott and Labor were invited to respond immediately last week to Labor Secretary Arthur Goldberg's order to end a walkout at the National Nuclear Test Facility at Mercury, Nev. The walkout, caused by a jurisdictional dispute between two unions affected such an underground testing: Nevada, Kiva B and Pluto programs.

Rodde Airbus last week proposed a night coach line between New York and Miami lower than all current air, rail and bus rates. The airline also proposed increasing free baggage allowance from 40 to 100 lb. The rate also would be \$29.54 eight weeks between the two points. Rodde now operates nine cargo and charter services.

Air Cushion Contract

Washington—Navy Bureau of Ships reports soon to award a contract for the design and construction of an air cushion vehicle 20 ft x 65 ft and weighing about 20 tons. It would be the largest such craft ever built by the U.S.

The vehicle's purpose is to test the probability of using the craft over water. Navy hopes the vehicle will travel at least 70 in. riding 2 ft above the surface. Officials feel this would enable the craft to fly over waves up to 3 ft high.

The craft will be powered by four Solar Stratos 1,400-hp gas turbine engines, and have nine dies and an auxiliary jet. Delivery of the vehicle is expected in mid-1971. Navy proposals were received by the Navy last fall. Bids on the design may include suggestions with one of the contractors by next month.

British test series is to test a small vehicle built by Saunders-Roe, Kingston, in the 1950's. The British vehicle is designed to carry 60 passengers over water.



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THE RAID ON VIENNA

LEACH HERITAGE OF THE AIR — 10

Thousands of leaflets in the colors of Italy rained down on the Austrian capital, urging the Viennese to surrender. Overhead, a squadron of Italian SVA-5 pursuit planes circled the city, dropping more propaganda and aimed off toward the Adriatic.

At their head was Major Galeazzo D'Annunzio, commander of Italy's famed 8th Fighter Squadron, "La Seregnaia." The date was August 9, 1918. D'Annunzio, then in his mid-fifties, had organized and led one of the greatest feats of World War I.

Leaving their airfield near San Polo, the eight fighters had flown over treacherous mountain terrain for more than 200 miles to reach their objective. On the flight from Vienna, they refueled by an alternate route that took them near the Adriatic and then home for a round-trip flight of nearly 300 miles.

D'Annunzio—poet, dramatist and aviator—flew an SVA-5 that had been modified into an unarmed two-seater. Its fuselage was emblazoned with the insignia of the Winged Lion of

St. Mark. D'Annunzio previously had served in the cavalry and navy, but was given distinction for his daring bombing raids. He was wounded a number of times, and by the end of the war had won six medals for bravery. He later was promoted the title Prince of Montenevoso.

The plane in which he flew to Vienna on the propaganda raid is still preserved in the "Vittoriole," D'Annunzio's home near Bolzano, which is maintained as a public museum by the Italian government.

The SVA-5 was among the most efficient and structurally unusual planes of the era. Powered by a 6-cylinder, water-cooled vertical S P A engine, the plane's top speed at sea level was a remarkable 145.7 mph. Buoyed at 230 hp, the engine actually delivered 225 hp at 3700 rpm. The ship could climb to 33,000 feet in 8 minutes, 30 seconds, and to 28,000 feet in nearly 32 minutes.

Armed with two Vickers guns—which were mounted just forward of the cockpit on either side of the cowling—the SVA-5 weighed 1685 pounds when loaded. This included a 575-pound load consisting of pilot, armament and fuel. The plane's most distinguishing feature was its four legs, which were rectangular in front and triangular behind the cockpit.

The aircraft was designed by Ing. G. Venduina, whose first consideration had to be the area over which the ship would fly. To strike at their primary enemy, Austria, the Italian had to achieve an aerial target. In addition, the Italian Flying Corps had the problem of going over the Apennines and the Alps to reach Vienna or Munich, which necessitated high maneuverability.

At war's end, nearly all pursuit squadrons were equipped with the SVA-5, and other special units of the corps were flown by the SVA-6 biplane, a sister ship incorporating virtually identical design principles. Together, these planes formed the backbone of Italy's air strength against the Central Powers from the summer of 1917 until victory.

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Fare Issue May Be Used to Push Mergers

Airlines believe Board may reject pending requests for increase to sharpen interest in consolidations.

By Robert H. Cook

Washington—Speculation that the Civil Aeronautics Board intends to accede to airline requests for increases in fares to offset losses caused by weak airfares is being used by airlines to push for consolidation.

Continental Airlines' filing for a "no frill" coach service (AW Nov. 4, p. 37), scheduled to become effective on Dec. 1, is widely regarded by the industry as a test of CAB's low fare philosophy against the traditional logic for extensive fare increases to offset the record air losses expected this year.

The Board must either approve or disapprove the Continental fare before the end of the week and act shortly thereafter on a fare increase proposal filed by United Air Lines, which must become effective Jan. 1. In addition, Eastern Air Lines and Braniff Airways have taken the unusual step of requesting CAB approval of their suggested fare increases by Dec. 1, before they can count themselves to fiscal year 80.

In a further indication, considered as a blunt ultimatum to the industry, CAB issued an order on Nov. 17 requiring an accounting of merger talks and warned that unless the airlines take such action, CAB might develop and publicly disclose its own merger report, outlining not specific cases but general trends as merged.

National Airlines, already after the Board's decision, withdrew its request to raise its coach fares to within 55% of fare-plus-base. Later, it filed for a new "red" coach fare between Boston, Washington and Miami.

Eastern wrote a letter to CAB asking a Board opinion on a proposed fare increase of 3% to 7%. The carrier also planned that it close this course of action to avoid any unnecessary exposure that might be incurred in filing a tariff that CAB might reject. Eastern said the proposal also would include sharp discounts for local and long-haul service on coach flights—more than Board has

strongly urged, but that industry has not yet agreed on.

Braniff, in a similar letter, inquired about the possibility of a 6% to 7% fare increase, with the additional proviso that it would also drop food and beverage service on coach flights.

Consensus of opinion now is that there is little hope for any fare increases until after the industry's year-end financial figures are tallied.

Profit Outlook

Last year the domestic trunk airline made a meager \$1.2-million profit, with a profit margin of only 0.1%. Debt interest totaled \$49.5 million to produce a 2.7% rate of return on investment, or \$127 million less than is needed for the industry to realize the CAB-regulated 10% return.

With a current net loss position of more than \$17 million, projected returns of the industry's financial status by the end of this year indicate an expected profit margin of -1.1%, with a debt interest of \$66 million and a rate of return of less than 2.2%.

Unable to generate enough total fare volume to offset revenue losses from the increasing amount of low yield coach traffic, more carriers fear that a fare increase of more than 10% is needed to recover these losses at the present rate of growth, which has plain sailed from 15.1% in 1979 to only 9.1% in 1980.

Fare increases already suggested do not take into account either the industry's continuously rising wage costs or the strong possibility of a full system of new charges to cover the cost of operating the federal airway system, which officials point out.

Sellers there short an estimated 42 cents of each revenue dollar earned by an airline, one spokesman said. Of this total, crew costs are more than 15 cents. Fuel costs and taxes, which would be severely affected under any extensive user charge program, currently claim 34 cents of the dollar.

Earlier studies by a Senate transportation committee have estimated that a user charge industry might cost the airline industry \$100 million a year, or equating a 7.1-15% fare increase.

As an example of the impact of rising wage costs on airline carriers, a United board noted that increases granted this year have needed operating expenses by \$2 million. United estimated that its required fare increase to offset losses from about \$27.5 million, but would produce a rate of return of only 5.2%.

Strikers Reclassified

London—Ministry of Aviation has now reclassified an official government wage freeze for its members, by voluntarily 1,000 London at London Airport in strike a strike (AW Nov. 20, p. 38).

London, striking for five more hours, has been reclassified as the joint two of baggage handlers, estimate 1, a job which for the wage increase which started the dispute. United has said it would increase wages, which shows a loss of \$750,000 because of flight cancellations.

Victory for Board

Psychologically, the Board appears to have won a tactical victory in its battle to hold the line on fares, because of these developments:

• **Continental**, with the industry's high cost record, has not asked for a fare increase, but has asked CAB approval of the new reduced fare coach seats when the Board considered and approved a special seat designed for this service.

• **Trans World Airlines** and **American Airlines**, both directly competitive with Continental on routes from Chicago to California, filed several letters in the Southwest, filed strong objections to the low fare idea, but decided to satisfy the service as a competitive measure. TWA also asked permission to extend its present transcontinental jet reservation plan and add a new and lower price coach fare between New York and California.

• **United** is thus faced with the prospect of conceding a fare increase while its major competitor holds down its fares. Given its deep-seated desire to increase fares, the CAB may accept this increase proposal by Jan. 1, but many observers believe United will withdraw its proposal if the Board approves the Continental fare. United later filed to meet the TWA increase fares.

• **Alan S. Bond**, CAB chairman, said the

McNamara Tightens Supplementals Rules

Washington—Defense Secretary Robert S. McNamara said last week that only supplemental orders must receive Military Air Transport Service clearance to use military personnel orders for commercial U.S. Supplementals also have been from certain individuals related to military personnel in the U.S. to the case order.

Approximately proposed by the Federal Aviation Act that 145 Air Force units in 1980 (AW Nov. 20, p. 37). McNamara's ruling requires Military Air Transport Service to issue supplemental orders to use military personnel in the U.S. to the case order.

Supplemental orders, which have been subject to similar restrictions for several years.

McNamara's action, which became effective Nov. 30, will direct all military personnel serving on an individual basis in the U.S. to maintain and keep service records. This change is important because some for the people records.

CAB Grants Emergency Hearing On Financial Aid for Northeast

By Ward Wright

Washington—Civil Aeronautics Board has granted Northeast Airlines a second hearing on Nov. 29 to consider interim approval of emergency financial aid from Hughes Tool Co.

The Board took the action after Northeast wanted CAB to take to allow Hughes Tool to give it immediate financial help (AW Nov. 20, p. 30) would force the airline to ask for advance as go into bankruptcy proceedings.

CAB and the Northeast financial picture was serious enough to warrant a second hearing to consider the situation. The Board said it would not rule on the emergency financial aid until a full hearing regarding the airline's financial picture and the scope of the crisis and how and whether to act on Nov. 29.

CAB agreement is unlikely the last precedent step before the Board's final decision.

Hughes' Control Announced

The Board said that it would accept the question of financial aid to the airline. For the purpose of the hearing, the Board said it would assume that Hughes Tool should control Northeast as well as financial assistance is granted.

CAB noted that it was aware of Northeast's claim that control by Hughes Tool does not exist and would not if it were financial aid, but that it was "highly concerned" on that issue and would not explore it further at present.

In addition, CAB said that whatever it decides on interim financial aid there will remain for later decision after a full hearing, hearing. The question, whether evidence of control by Hughes Tool does exist or not, will be decided by the Board.

based on the total \$5 million Northeast said and it even, the remaining \$5 million cash transfer would be "shaded from the picture."

Valley Airlines, Ltd., which holds significant stock certificates in Northeast, said it would like to have a say in the picture. Valleys said it would like to have a say in the picture.

In October, Valleys and it helped a plan to allow Hughes Tool to have a say in the picture. Valleys said it would like to have a say in the picture.

The idea of the second last year to allow Hughes Tool to guarantee a Chase Manhattan Bank loan to Northeast to most part of its expenses after the end of the year. Valleys said the plan had the effect of making holders of Northeast's equity to have a say in the picture. Valleys said it would like to have a say in the picture.

As of the middle of last year, a Northeast spokesman told Airline Week. Valleys said it would like to have a say in the picture. Valleys said it would like to have a say in the picture.

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Local Service Talks

Washington—Civil Aeronautics Board Chairman Alan S. Bond has asked local service airlines to make a deal with him in order to avoid a possible bankruptcy, capacity and management problems.

Bond said local service requirements might be as much as 10% of the total, but he said he would like to have a say in the picture. Bond said it would like to have a say in the picture.

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Revisions in FAA Policing Policy Urged

By David H. Hoffman

Washington—Federal Aviation Agency reforming and reforming programs are expected to become more democratic, more consistent and more decentralized in the Agency's implementation recommendations submitted by it last week by the Project Tightrope task force.

The initial step in this decentralization is an Agency Reorganization Commission set up by the FAA Administrator N. N. Hobbie—will take last week when the Agency discussed the contents of the Tightrope report. The commission, to be headed by Hobbie, would include the following members:

- Create FAA rule making policies and procedures
- Determine when release of a proposed rule should be issued
- Review the rule making process from outside the Agency are given "serious consideration"
- Demand complete justification before drafting any rule proposed by an FAA official
- Discuss a valid FAA project need as a self-defense and strengthening rule already on the books
- Separate and coordinate the work of several divisions directed to implement all FAA rules

In addition to Hobbie, the FAA's general administration—when one is appointed—the director of the Air Traffic Service and Flight Standards Service, the civil air inspectors, the FAA's general counsel will act as participants on the council. The director, management of the group will be headed by an executive director, W. Lloyd Lane, who chaired the FAA's initial study group, has been paid for this post and it should take no later than Jan. 15.

Report Recommendations

Lloyd Carter, a Washington attorney, served as chairman of the Tightrope task force. In accepting his report, which took four months to prepare and write, Hobbie said that the report is "principally, with certain exceptions, the project's major recommendations on rule-making."

"The report suggests that functions of the rule-making should be assigned to an 'independent administrative' rule-making body, which would act on the advice of a committee composed of top-ranking FAA officials. Hobbie's administrative reorganization of FAA virtually sets out the structure of the new body.

The report was largely critical (AW Oct. 16 p. 47) in its criticism of the agency's lack of uniform FAA rules across the country. It noted that in the 12

months following former FAA Administrator William R. Steuding's "back door" or "indirect" approach that ended on June 30, 1975, violation reports jumped 50% from 2,092 to 3,123. During the next 11 months, 6,444 violations were reported.

Enhanced efforts in FAA's West region headquarters were unable to cope with this "burst of activity" from the field and the entire complex system was delayed, the report said. As a result, Douglas advised his associates to use more "judgment" in filing their reports. Violation reports fall into an average of about 170 per month to 185, a rate that is continuing, the report said.

An even greater decrease in the number of cases reaching Washington followed Douglas's order. Even so, the report noted, about 55% of the reports processed through FAA's headquarters have been rejected by Agency officials.

"No matter how complexly law is the inherent of individual cases, an agency which automatically drops or rules all of the proceedings it starts and which has no way of knowing if the rule is being followed, is not a good agency," the report said, "ought not to be questioned," the report said.

Hearings Urged

To remedy the situation, the Tightrope task force recommended that in cases involving the revocation or suspension of a certificate issued by the FAA, the Agency should hold a "real-time hearing" before an independent hearing committee. That office would be empowered to decide cases and report recommendations to the review of the administrative. It also recommended that the report of a hearing, which would be conducted as an admission of guilt and the case would be called after a hearing, would be reviewed and approved by the Civil Aviation Board.

FAA's field inspectors, totaling 900, are not adequate good investigators, the report said. The agency said they had to increase and investigate violations, dilute their effectiveness, it said. Greater efficiency could be achieved by the appointment of a "specialized investigation" independent unit.

Almost all enforcement cases now are subjected to "multiple internal review" by FAA, the report said. This system should be "severely pruned" and consequences reduced by policy decisions and general regulation.

The report recommended that FAA's audit growth rate needed in "some districts" during the Agency's five-year plan. To illustrate, Dec. 31, 1975,

the day FAA rose into existence, through 1974, the Agency processed 101 Civil Air Regulations, of which 24 were first published as proposed rules, 115 regulations of the all constraints, of which 25 were published originally in proposed, 258 amendments and 100 regulations were published in proposed rules, and 1,097 enforcement actions, about all of which were first disseminated as proposals.

The volume of activity, according to the report, helped produce three problems:

- Fewer to meet rules were executed separately by individual FAA offices—Flight Standards and Air Traffic, for example. As a result, the regulatory philosophy, the format and the formal procedures required often varied widely from rule to rule.

- Conflict between the effect of the general counsel and Flight Standards Bureau on these "regulatory" rules in the rule-making process, severely delayed the promulgation of vital rules.
- Internal discretion was given the effect of "secret rule" by the Agency," the report said, "ought not to be questioned," the report said.
- Based on internal rules of FAA as "locking in" policy, regulations, amendments in terminology, composed in some of writing and legal language, often is published, with no one having a complete set of knowledge and with no central table of contents or index to permit search and return information.

Notions of proposed rulemaking, the report said, frequently are published only after "the Agency has largely made up its mind" on the subject at issue. The report said, "ought not to be questioned," the report said.

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SAS May Cancel 990 Order

Capehaguen—Swedish Airlines System is considering a number of financial arrangements, including possible cancellation of its order for 990 aircraft, to meet its obligations to the Federal Aviation Administration, according to Swedish Ministry of Public Works K. Lindberg.

SAS management also is considering a request for one look outside beyond the approximately \$30 million advanced only this year by the governments of Denmark, Sweden and Norway (AW Mar. 27 p. 14).

The company said that it has over the order's North Atlantic route had declined 45% in the last six months, 30 below that reported during the previous year. Despite cancellations of the two 740s on order from Boeing plus two it had placed to obtain on a lease basis from Boeing might prove difficult, Swedish Airlines said.

Swedish Airlines said that SAS plan to cut its order substantially from last month's order of 21 flights per week in New York to a total of 14 to from the South Atlantic and South American schedule from two to one per week.

CAB Examiner Declares Airline Credit Programs Are Unlawful

Washington—Internal documents by a Civil Aeronautics Board examiner that credit plans used by scheduled airlines are unlawful, it affirmed, that the order to cancel them, the 5425 department of the Universal Air Travel Plan.

CAB Examiner Ralph L. Wier found that airline credit plans are unlawful in that they entered credit without charge and are not available to all passengers on equal terms. If the Board approves, he would have the industry report its credit program within 90 days after the Board act.

Wier found that the industry would be affected by the order, the Universal Air Travel Plan, which has been the backbone of the airline credit system since 1926, would be broken. He believed the plan is required to deposit 5425 with the airlines, and the amount of deposits held by the industry has reached substantial proportions.

Wier's Recommendations

Under Wier's recommendations, airlines would be required to charge full amount to the Universal Air Travel Plan 2% of the amount of the first billing and 1% on all billings. In addition, airlines would be required to pay 5% of the amount annually on customer deposits, with the interest to be credited on monthly billings.

An estimated 25% of all transportation as scheduled service is now purchased under credit plans. Subsidies total nearly one million. American Airlines, which has the largest number of UATP accounts in the industry, showed credit deposits totaling \$10.3 million in its Dec. 31, 1968, annual report.

Wier recommended that UATP provide "a valuable service which gives the

passenger afforded credit an under preference and advantage and unfairly, all other passengers in an under preference and disadvantage." He added that the order to cancel them, the 5425 department of the Universal Air Travel Plan is unlawful unless certain terms, a paid in that it is restricted to the volume of business and therefore in many different cases to different customers for an transportation, in violation of section 601.65 of the Act.

Wier also found other credit plans and consumer credit plans unlawful in that they are not offered in uniform, in addition to the UATP but two of over four other airlines. American Airlines, for example, offers on its own Country Club Plus to persons who have established credit to British Airlines.

Nonmember credit plans include general purpose programs such as those offered by the American Express Co., Travelers Club and the British Credit Corp. Several airlines have agreements with one or all of these organizations.

An annual review charge is collected from the card holder, American Express, for example, charges each customer \$5 per year. In addition, the airline pays a percentage of sales to the credit organizations 2% to American Express, 4% to British and Travelers Club.

Wier found that use of such cards is limited only by the airline's credit policy. The airline charges the full rate for all tickets. He further recommended that certain bill the credit agencies within 15 days after the billing and that the entire amount should be paid within 30 days.

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passenger afforded credit an under preference and advantage and unfairly, all other passengers in an under preference and disadvantage." He added that the order to cancel them, the 5425 department of the Universal Air Travel Plan is unlawful unless certain terms, a paid in that it is restricted to the volume of business and therefore in many different cases to different customers for an transportation, in violation of section 601.65 of the Act.

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Public Unwilling

They said the public is unwilling to accept a credit charge.

Wier stated that the CAB has never focused attention on the question of whether credit programs should be charged for the service. He added further:

"Sound policy requires that charges be placed to cost airlines or practitioners. Application of this policy would require that users of air transportation pay a price reasonably related to its cost, that use of an account service such as credit pay a price reasonably related to its cost, and that those who do not use a particular account service be able to buy an transportation without paying for the account service."

Canard Loses Award

London—Canard Eagle Aeronaut last week lost its right to establish its service on the North Atlantic while Atlantic Air Transport. The company's appeal to the Civil Aviation Board was rejected. (AW Oct. 27 p. 2).

Thereafter, the company, which has been operating since 1926, will be forced to operate its service in competition with BOAC between London and New York.

Before the statute's decision, Sir Fred Pickford, commissioner reported in the appeal recommended revocation of the license on the grounds that BOAC has commitments to aircraft purchase—55 Vickers VC10s—to enter for all the traffic expected for the next five or six years.

Pickford also said the advent of an owner British flag service would cause serious damage to BOAC. But points were taken when in BOAC's appeal the General Eagle license.

Pickford claimed that withholding a license to growth of traffic destined to meet an owner British flag service would cause serious damage to BOAC. But points were taken when in BOAC's appeal the General Eagle license.

Canard Eagle's chairman, Harold Pennington, said Canard's sales for last year were 70% from New York and were not considered on giving the North Atlantic route.

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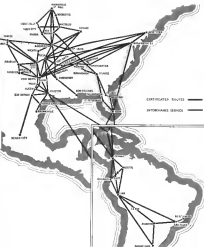
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Charles E. Reed, President, Braniff International Airways has been one of the decision makers in the One-Eleven. "After studying many One-Eleven's in comparative studies, it is not uncommon that the BAC One-Eleven is the short haul jet most adopted by the airlines in which we plan to operate them. The simplicity of the BAC One-Eleven combined with its operating characteristics makes it unusually suitable for an operator with a market of wide area which must fly to an airport of 150 miles or more. We already have large jets for the longer hauls. The BAC One-Eleven will bring economical and customer jet travel to the customers who make the short flights."



IN PRODUCTION AND NOW FLYING. Specifically designed to fill the need for an all-service heavy transport helicopter, HC-119s are now in large-scale production. With less than five hours logged following initial forward flight, the first HC-119 flew 150 miles an hour—at a gross weight higher than normal maximum. Since then it has flown at 150 mph for long periods, under various operating conditions. Pilots' test reports consistently read "No major problems." The new helicopter, in addition to aircraft carrier compatibility, embodies the features required by both the U. S. Army and U. S. Marine Corps—large cargo compartment, rear loading ramp, freedom from balance problems and inherent flotation capability.



NEW HC-119 HELICOPTER, HEAVY TRANSPORT, AT 150 MPH DURING FLIGHT TEST.



Aeroflot Draws Gibes From Soviet Magazine

Now, according to Soviet magazine *Krasnaya Zvezda*, the Aeroflot crew spent a "confusing" night of official banquets and the Soviet embassy, while passing their evenings with better musical facilities.

They spent special correspondence, as made in *Vladivostok* that the evening in describing their experience in *Krasnaya Zvezda*, where they landed following a mission to the flight from Moscow.

"We found that there would be no place going to *Vladivostok* that day. They didn't know," he said.

"You'll find out about tomorrow's plans tomorrow," the elderly lady of the information bureau replied with a smile. "Don't be in such a rush. Spend your evening calmly."

"That was learned that there was no place to spend the night. The report had said that we had to go. And so, after waiting the night of the night *Krasnaya Zvezda*, we returned to the airport without meeting. They then arranged us again."

"People seemed to cheer and on the floor. They tried to increase their numbers. They were never denied to go to the airport."

"Guests gathered in groups, took on the street there, where the office of Comrade *Vladivostok*, the airport chief, a house, since he doesn't get to work until 9 a.m., sleeping was for several hours."

"We learned the *Vladivostok* plane from *Krasnaya Zvezda*'s management doesn't want to lose *Krasnaya Zvezda*'s and is determined to continue providing it with material in the interest of the country."

FAA Shifts Development Emphasis To Follow Project Beacon Plan

By Philip J. Klein

Washington—Federal Aviation Agency has started to correct its development effort to follow Project Beacon recommendations and is preparing a revised design plan as a guide to future development.

Preparation of the plan has been assigned to a three-man study group headed by Joseph D. Blitt, director of FAA's Aviation Research and Development Service (ARDS), to perform a function previously lacking in the agency.

Blitt of the team retention will be experts in different operational aspects of overall traffic control system design, while the members will be specialists in the technical development required for system implementation. Team members will devote full time to the project all but three members on the team have been told.

Agency officials, Russell E. Blitt, senior advisor, Robert S. Nuckelberg, chief and president, Albert R. Rubin, chief, human factors, H. R. Van Sledright, chief, facilities configuration, Arthur L. Withers, chief, external system interfaces, Col. Gerald M. Wolfe, chief, weather support, Col. John W. Hinkley, chief, data acquisition, Lawrence E. Shaw, chief, communications, Walter B. Taylor, chief, navigation, Alexander B. Winkler, chief, systems.

The agency is seeking candidates for the three remaining slots: overall performance characteristics, data processing

and data display. Selection will go as high as CIV-100 as indication of the top-level personnel being sought.

The team is now studying the Project Beacon report, recommendations by a committee with aerial emphasis on the technical side. As such, the team is now studying the report, which was recently issued by Joseph D. Blitt, director of FAA's Aviation Research and Development Service (ARDS), to perform a function previously lacking in the agency. The team is now studying the report, which was recently issued by Joseph D. Blitt, director of FAA's Aviation Research and Development Service (ARDS), to perform a function previously lacking in the agency.

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of an ATC. No action requires special knowledge of many technical disciplines and operational practices. There is no single organization, or group of organizations, outside FAA with all of the requisite knowledge and experience.

Blitt also indicated that FAA staff intends to conduct and manage the development of the system, rather than work through private contractors. In an earlier FAA concept of the development and its compatibility with the agency's concept.

Although the Beacon report clearly recommends the automation of FAA's primary effort in developing a new automatic traffic control system, the change does not seem to be in the line of the system of the system and techniques developed under the previous program.

In a report to Blitt, Blitt said that a working paper prepared by the Beacon staff, since by ARDS "is reflected throughout the Beacon report. With this, the Beacon report, the equipment and procedures proposed in the Project Beacon report are now and have been in the process of development by ARDS."

The Beacon recommendations that underlie the primary advances for traffic controllers and that the flight program step become secondary, reverse the concept in which the primary system was designed. This probably means that the program for automatic sequencing of individual flight steps in the traffic control computer on each controller's console will be abandoned in favor of a single high-speed system, which would automatically sequence each step of the flight plan into a single point of new flight steps incorporating on changes in flight plan since the previous program.

However, most of the concepts discussed in the Beacon report and overall overall design sequence in the time and space can probably be used in the Beacon type system with only slight modification, according to Blitt.

The experimental system, currently installed at FAA's National Aviation Facility Experimental Center (NAFEC) in Atlantic City, will be used as a test bed for the system of techniques recommended by the Beacon report. Blitt said. NAFEC had been working on the system portion of the system, but has now shifted emphasis to the technical side.

Project Beacon recommended that radar location with automatic altitude reporting provisions be used to provide basic information, but the FAA plans to continue its present reliance on the Mexico height radar radar. Blitt said. The team has not yet considered the question of data link and the extent to which the FAA should continue its efforts in this field.

Australia May Ease Rigid Airline Control

By L. L. Doty

Melbourne—Australia's 10-year-old policy of rigid control of competition in civil aviation is still undergoing serious tests that could bring about a revision in domestic airline rules patterns.

There is no question that the policy, which is based especially at preventing excessive capacity and wasteful duplication of schedules has attracted serious criticism in providing Australia with the airline service it needs. But there is serious doubt that the policy will permit Australia's airline system into a strong, self-sustaining business enterprise with a sound potential for future growth.

Government Policy

Essentially, the policy calls for a single flag carrier serving international routes only, a dual airline system operating under strict government, not semi-independent, control on all domestic interstate routes and a highly subsidized feeder line system serving essential rural and developmental areas.

Although government-owned, the international carrier—Qantas Empire Airways—has long played substantial

operational independence and that has become a strong international competitor, particularly on the Sydney-London "Kangaroo" route and the Sydney-U.S. route. On the basis of revenue tax rules handed, Qantas ranked as the world's seventh largest carrier in 1969.

Controlled Competition

The two domestic carriers—the government-owned Trans-Australia Airlines and the privately-owned Ansett-ANA—do not enjoy such freedom. The government requires them to compete with one another on most major routes, which is often economically inefficient. Yet it controls that competition by requiring each carrier to provide no more than 35% of the available seat capacity on a given route, by limiting the type and quantity of aircraft each carrier will purchase and by indirectly regulating routes, schedules, rates and fares.

Surprisingly, the unaccounted Liberal government, headed by Prime Minister R. G. Menzies, appeared to favor Ansett-ANA when it was exposed in its own airline, TAA (Unitedair), this is due to the fact that the Liberals would single out the state-owned airline

when it wanted control in 1969 from the Labor Party, which rules in power, was based on outstanding major industries. As a result, the fact extensive national Liberal government has unwittingly made Australia's domestic airline system a political issue. In fact, the fierce with which the opposition on the Liberals trust Ansett-ANA, may become a significant part of Labor's platform in the federal election next month.

Despite the shortcomings of the present airline rule-up, more rather than less, it is clear that the overall policy is working better than originally anticipated. Service is exceptionally good. Domestic fares are the lowest offered in most other countries, despite two increases totaling some 15% in the past year.

Government Backs Expansion

Expansion of developmental routes into outback areas is continually sponsored by the government. And 72,000 sq. mi. of outbacked air routes have been built, major cities with more rural and bush communities, which are inaccessible by surface surface transportation.

However, Australia's 10.5 million people, 70% of whom live in the south east corner of a continent roughly the size of the U.S. do not produce a high density traffic, although Australians, on the basis of population, are scheduled an average more than twelve of any other nation. Many economists have said that Australia's new policy has created an over-abundance of competition, that the country's small population cannot support it.

In the past, the government has supported that competition by using domestic airlines will automatically produce better service, a philosophy that has a historic parallel in the U.S. It also believed that stiff control of the competition would not allow individual airlines on grounds that each can now) intensify its drive to become a carrier by achieving high load factors while still by scheduling extra capacity.

It now appears that the government is having some doubts over the effectiveness of this policy. For the 22 months ending June 30, domestic traffic declined 1.2% compared with the same period last year. The government is nowing the decline as particularly serious since the profit rate of the domestic industry is not much over a marginal 1%.

At the same time, the government has indicated that a continuation of the competitive system depends entirely on future traffic growth, although it has not

specifically made a decision to change its policy.

There are signs that the government is anxious to reduce competition and the feeling here is strong that Ansett-ANA will be the beneficiary, and that TAA will be the victim of such a move. If the Labor government returns to power, which is not considered likely, TAA would emerge as the leading carrier.

Then Australia's domestic airline industry faces the possibility of a slow but steady change in the present government's rigid airline policy, or the more realistic chance of an abrupt change if another political party comes to power.

At first glance, this fluid situation might suggest that the airlines are disadvantaged from a marketing standpoint. However, Nothing could be further from the truth. Between 1954 and 1958 both domestic and international carriers in regular transport operations had a perfect safety record. In 1960 accident statistics show 137 out of 100 million passenger miles. Aircraft still maintain a high on time performance in dense traffic and the airlines are able to maintain and experienced safety techniques.

Agreements Extended Authority

The federal government originally was granted permission only over aviation safety matters. In power to regulate competition and control capacity—the core of the present civil aviation policy—came solely from agreements signed with TAA and Ansett-ANA. The agreements were extended by Parliament last month for a 10-year period and after a hot political debate, indicating the continued character of the policy.

First agreement was signed in 1957 after the Liberal government concluded that it was opposed to a single national airline serving domestic trunk routes against uncontrolled competition. The 1961 Australian Agreement, therefore, provided that the government-owned TAA and the now privately owned Ansett-ANA should serve Australia's primary domestic routes.

Under the agreement, both airlines were to have equal access to national government business. Local passenger rates to be afforded ANA. The agreement also required the airlines to keep under review "air routes, timetables, fares, freight and other related matters." In the event of failure to agree on any point, an arbitrator would be appointed to resolve the difference.

From the beginning, the agreement was not entirely successful made because of TAA's economic advantage over ANA.

Equipment purchase was an example. TAA bought Boeing 740s while ANA



Dodgers to Fly in Customized Electro

Los Angeles Dodger baseball team has taken delivery of a Lockheed L-1049 Super Constellation aircraft and plans to use it for its home and international flights. The aircraft has seats for 64 passengers and sleeping accommodations for 4.

bought Douglas DC-6s, giving the lowest air passenger with the highest speed and passenger comfort of the Constellation. Later when ANA re-equipped with the Douglas DC-4B TAA went a step further in strengthening the popular turbo-propeller Vickers Viscount.

Meanwhile, Ansett Airlines and Butler Air Transport, both of which were operating outside the provisions of the agreements, provided additional competition to ANA. As a result, ANA's first competitive flight, the Sydney-Melbourne route, was scheduled in 1957, it sold out to Ansett, leaving Ansett-ANA.

Subsequently, Ansett obtained control of State and air authorities. So far, subject matter has not been introduced domestically. Earlier this year, the government authorized calls for a purchase of two turboprop transport for delivery after 1964. Orders cannot be placed before 1965, although both airlines are now making technical collection of available aircraft. Final decision will be given by a government working that acquisition of the turboprop will be based on the need for a broad capacity resulting. The government added that it does not intend "to approve a wholesale replacement of the existing turboprop fleet which will continue in use for many years."

The present government's revision on capacity is related to equipment is reflected in a statement by the Minister of State for Civil Aviation, Stuart Ashbridge, at the recent Labor national Air Transport Union annual general meeting in Sydney last month (AW Oct 25, p. 31). He said:

"One of the objects of the parties to that agreement is to create and maintain a position in which there are two, not more than two, operators of trunk route airline services, one being the Commission (CAA), each capable of effective competition with the other."

To prevent occurrence of an equipment imbalance in competition and to



MAP shows domestic trunking competitive and non-competitive routes served by Australia's two largest carriers, the government-owned Trans-Australia Airlines (TAA) and the privately-owned Ansett-ANA. The trunk routes are supplemented by a wide network of developmental or feeder services, which are not shown on the map. The network of feeder lines serves remote areas of the continent.

in the early 1960s, the international airline industry today is grossly over-provided with jet aircraft and load factors have fallen to uneconomic levels. This threatens the continued financial stability of the industry.

Australia's philosophy of autonomy in equipment purchase was further underscored by the Prime Minister when, at the ICAI meeting, he warned that the industry cannot try to "keep up with the times without the cost of keeping up with the times may be" the added "The last thing... I want to happen is to have international airlines flying to the water in the hope of being able to sell what they are not actually selling or to something that inevitably cannot live except with massive subsidies.

In February, the two-track policy was extended into New Guinea when Aerolin showed Minsat Airlines and began to operate in competition with TAA. Papua is served by Popayan Air Transport, which last year carried 14,996 passengers on its 140 weekly flights.

Indonesia paid for operations over non-competitive and "development" routes totaled slightly over \$1 million for the year ended June 30, 1961. In all, the Indonesian government plans to provide funds to state governments for the further development of airports

throughout the country to expand services provided by the Indonesian airlines.

At present, only Sydney, Denver and Bombay airports are equipped with runways adequate for jet aircraft. Plans are under way to expand the runway at the Perth airport and an additional jet runway will be added to the Sydney airport by extending an existing runway into Botany Bay. Sydney is the main port of entry for international flights.

In April, 1960, the Commonwealth government transferred the air routes operated by Qantas between Australia and New Guinea, and those within New Guinea and Papua, to TAA and Aerolin. Beginning in July, 1960, both airlines started equally in a five flight per week scheduled on the Sydney-Bombay-Puerto Morelia-Los Angeles route. New, each carrier operates three flights weekly.

Later TAA acquired the assets of Qantas in the New Guinea-Papua area and, only this year, Aerolin-AANA purchased Macleod Airlines, several operations on New Guinea, which routes had bought out Gibbo-Sepit Airlines and Malabar Airlines. Since provision of the civil aviation agreements apply to all carriers controlled by Aerolin, the effect was to give the dual airlines parity with an equal share for each airline of all traffic to and within New Guinea.

Varig's Jet Orders Linked to Goal Of Globe-Circling Service by 1963

New York—Varig Airlines of Brazil expects to become a transoceanic world carrier within the next year or so, according to Renato M. Brito, the airline's president.

Varig's international operation until last spring covered routes between New York, Rio and Buenos Aires and from New York to the Caribbean and Brazil. Then it bought 40% of the voting stock of Aeroline Brasileira, the national division of Real Airlines, with routes to Manaus, to Los Angeles and to Tokyo (AW No. 15, p. 45). Last August, Varig purchased Real entirely, taking over domestic as well as international routes.

Under Varig management, the old Real route to Tokyo was suspended pending replacement of jumbo equipment by jet. Brito told Aviation Week that jet service to Tokyo will be inaugurated next April on a weekly basis and increased to twice weekly by the end of next year.

Coupled for the 1963-64 period is a return to the Tokyo route on to Bangkok, Cebu, Cebu and Rio to complete the round-the-world circuit. Also, Varig is testing routes beyond Tokyo to Hong Kong and Bangkok, Brito said. The pro-

ject. About 50% of Brazil's domestic service is now provided by the Varig and former Real routes, Brito said, and 60% of the international service. Varig is expected to receive a domestic approval to allow the line of flight to America to feed its international routes.

To strengthen the Varig Real pattern from an equipment standpoint, types of aircraft will be reduced and possibly Ecuador will be ordered to handle some domestic routes. Brito and several other executives are under consideration to replace some existing pattern equipment. Fleet to cover both Varig and Real route systems would require eight or ten 707s, 100s, and possibly the present 10 F4s. For the Real pattern, Ecuador, Convair piston-engined equipment, DC-8s and C-54s would make up the fleet. Varig's pattern will be handled by Convair, 707s, DC-8s, 90s, and possibly Electras.

Varig's absorption of Real reduces the number of Brazil's international operations to two. It has been expected that ultimately one carrier will carry the Brazil-Brazil leg, and this development now depends on what happens in Paris.

Brito said nothing of Panair will not be on Varig's initiative, and that he knows of no definite steps at that distance of persons by the government of Brazil. Before the recent resignation of Jose Guedes in Brazil's parliament, the government had strongly favored consolidation of the country's international airlines to save its foreign exchange and to make Brazil's aviation a national instrument of policy (AW July 17, p. 31).

Varig's policy of Qantas' government has steadily taken over the line, now government, Brito said, but details are still under study.

Jet Operations

Varig last week began jet service between Los Angeles and Rio via the west coast of South America. A route between the two points had been operated by Real, and has been operated with piston equipment by Varig since it acquired Real. However, the old route, which Varig was operating under the Real name, was Los Angeles-Mexico City-Puerto Morelia-Rio. The new route, which Varig will operate under its own name, pending government approval, runs Los Angeles-Mexico City-Lima-Rio. Lima was not in the old Real route pattern, but Varig is trying to get the Los Angeles service.

Brito said he expects a formal replacement over the route with the shift to jet equipment. However, Varig is asking the Brazilian government to extend for another five years government subsidy to cover the concept international operations and the domestic DC-8 routes.

Domestic Routes

On the domestic side, Varig wants to move out of its roots out of the former Real domestic pattern making the Real operation a domestic subsidiary of Varig, with the latter airline becoming possibly an international oper-

AIRLINE TRAFFIC - SEPTEMBER, 1961

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U.S. Int'l Traffic	Revenue Tonnes	Freight Ton-miles	Total Revenue Ton Miles	Operating Revenue Per Passenger
DOMESTIC TRUNKS								
Aerolineas	612,196	593,391	43.8	2,021,445	1,661,226	11,354,234	45,460,566	55.9
Boeing	174,513	167,813	43.8	114,757	114,757	1,205,511	1,205,511	47.1
Boeing	108,225	72,917	46.0	261,492	132,258	476,134	1,548,553	39.0
Delta	261,957	147,184	54.7	425,117	279,385	1,027,921	1,816,256	47.4
Eastern	615,294	295,547	44.6	1,264,356	585,847	2,546,578	12,771,648	34.5
Northwest	122,188	81,261	36.9	261,492	122,256	1,365,614	1,511,185	39.0
Pan Am	124,343	21,551	44.7	155,811	74,723	234,524	1,518,971	26.1
Southwest	182,173	182,173	100.0	145,277	145,277	1,354,385	1,354,385	47.4
TWA	413,163	295,426	54.8	555,811	148,488	5,487,136	12,286,153	47.7
United	168,415	106,415	34.4	1,014,526	1,408,174	6,945,267	16,141,421	36.2
Western	146,823	85,577	58.0	364,426	53,484	4,632,267	7,123,341	44.4
INTERNATIONAL								
Aerolineas	7,512	3,423	32.4	8,461	1,021	261,287	3,123,872	42.1
Boeing	10,349	27,414	48.1	53,371	10,913	182,188	2,846,215	35.9
Boeing	32,861	2,280	42.0	5,543	1,000	70,000	276,371	34.2
Delta	1,518	1,709	70.7	714	1,000	30,542	376,371	32.4
Eastern	36,129	15,134	36.1	1,844,534	1,449	334,816	3,525,371	38.1
Northwest	3,244	1,261	31.1	1,000	1,000	5,936	12,371	31.1
Southwest	40	40	100.0	1,000	1,000	1,000	1,000	100.0
United	20,468	40,858	61.3	1,136,451	7,112	762,255	6,404,574	46.3
Western	3,419	6,642	39.8	41,968	3,576	274,716	3,641,984	42.8
Aerolineas	180,189	292,182	57.8	1,816,125	1,816,125	1,816,125	1,816,125	39.8
Boeing	17,321	17,321	100.0	17,321	17,321	17,321	17,321	100.0
Boeing	42,442	385,959	48.3	3,332,181	17,189	3,332,181	20,844,340	46.4
Delta	11,248	26,123	45.7	96,927	96,927	454,961	2,957,122	41.4
Eastern	1,518	1,709	70.7	714	1,000	30,542	376,371	32.4
Northwest	3,244	1,261	31.1	1,000	1,000	5,936	12,371	31.1
Southwest	40	40	100.0	1,000	1,000	1,000	1,000	100.0
United	20,468	40,858	61.3	1,136,451	7,112	762,255	6,404,574	46.3
Western	3,419	6,642	39.8	41,968	3,576	274,716	3,641,984	42.8
LOCAL SERVICE								
Aerolineas	72,576	15,343	37.7	27,711	13,434	43,418	1,431,235	42.1
Boeing	10,349	27,414	48.1	53,371	10,913	182,188	2,846,215	35.9
Boeing	32,861	2,280	42.0	5,543	1,000	70,000	276,371	34.2
Delta	1,518	1,709	70.7	714	1,000	30,542	376,371	32.4
Eastern	36,129	15,134	36.1	1,844,534	1,449	334,816	3,525,371	38.1
Northwest	3,244	1,261	31.1	1,000	1,000	5,936	12,371	31.1
Southwest	40	40	100.0	1,000	1,000	1,000	1,000	100.0
United	20,468	40,858	61.3	1,136,451	7,112	762,255	6,404,574	46.3
Western	3,419	6,642	39.8	41,968	3,576	274,716	3,641,984	42.8
CARGO LINES								
Aerolineas	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Delta	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Eastern	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Northwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Southwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
United	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Western	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
WORLDWIDE LINES								
Aerolineas	28,123	4,481	50.5	3,346	1,000	4,481	301,748	51.0
Boeing	45,758	6,029	48.6	4,476	1,000	4,476	301,748	48.6
ALASKA LINES								
Aerolineas	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Delta	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Eastern	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Northwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Southwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
United	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Western	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
ALASKA LINES								
Aerolineas	7,354	5,740	39.0	43,544	2,615	1,267,867	1,844,328	70.5
Boeing	4,844	344	45.9	4,844	1,000	4,844	1,000	45.9
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Delta	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Eastern	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Northwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Southwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
United	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Western	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
ALASKA LINES								
Aerolineas	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Delta	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Eastern	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Northwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Southwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
United	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Western	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
ALASKA LINES								
Aerolineas	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Boeing	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Delta	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Eastern	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Northwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Southwest	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
United	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0
Western	1,000	1,000	100.0	1,000	1,000	1,000	1,000	100.0

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

AIRLINE OBSERVER

► **Response to the Senate Commerce Committee's request to form a task force for research on international air transport problems has been passed by the Senate. The committee has also requested that the committee for an investigation of international competitive and bilateral issues, but most of North Atlantic airlines withheld any comment. The chief reason is that the committee did not formally invite foreign carriers to submit comments until Nov. 6, and the deadline was not at Nov. 15, leaving little time for preparation of replies. In addition, several foreign carriers feel that in view of the U.S. drive to partial foreign competition, any comments submitted might be used against them by U.S. carriers during hearings.**

► **Franklin Industries Inc. of St. Louis, Mo., has announced a \$4.5-million drop in sales for the third quarter of 1961. In the past 12 months, total sales have slipped about 60% from the 1960 level and are now down to \$1.5 million.**

► **Southwest Airlines (SWA) has announced that it will operate a new service from Dallas to Los Angeles, with a stop at San Francisco. The airline will operate a new Boeing 707-300 aircraft on the route, which will be the first of its kind in the Southwest Airlines fleet.**

► **Scheduled international airlines reported a 3.2% increase in passenger traffic and an 11.8% increase in cargo traffic in North Atlantic routes during October, compared with October, 1960. Last month, during the month, reached 38.2%, highest of any month since October, 1960, when it was 38.1%.**

► **British West Indian Airways, now owned by the government of Trinidad, has announced a new schedule of flights to the Caribbean. The airline will operate a new Boeing 707-300 aircraft on the route, which will be the first of its kind in the British West Indian Airways fleet.**

► **Sabena's helicopter service may have to be abandoned, as sharply curtailed, or Air Union goes into operation. Under Air Union, Sabena, Air France, Alitalia and Lufthansa eventually would split resources on a fixed basis. The Sabena helicopter service, aimed at keeping passengers from European points into Sabena's long-range routes, no longer would be of practical use. Meanwhile, Sabena is delaying a decision on whether to buy a fleet of Sikorsky S-61 or Vercel V-107 helicopters.**

► **Eastern Air Lines survey of passengers using Airbus service between northern cities and Florida shows that 17% are first-class and 31% would have used ground transportation if Airbus was not available. A total of 51% gave "vacation" as the main purpose of the trip.**

► **United Air Lines Conquest service has maintained an average 78% load factor since the first trip transport was introduced into scheduled service July 14.**

► **Mitsubishi Heavy Industries of Japan is scheduling production order lines of 15 Sikorsky 198-2 military helicopters and seven S-61, helicopter transport. The manufacturer plans to expand production gradually, but will probably continue to buy direct from Sikorsky. North America now operating into 5-62 helicopter transports on the Tokyo-Osaka route, is a possible future customer. Japanese Army and Navy may buy the 198-2 military helicopter, ordered as the just by the Navy. Reduced seat pitch in the civil version from 34 in. to 25 in. will permit seating with 3 in. less clearance for 54 passengers instead of 78 passengers in the U.S. version.**

► **British Petroleum last week gave financial approval to United Kingdom participation in Ennaco, a joint high-velocity traffic control system, operated with other European countries. The agreement has already been accepted by France, Belgium, The Netherlands, Luxembourg and West Germany. The United Kingdom government expects that those of European countries would be required by charges against air airlines.**

SHORTLINES

► **American Airlines will begin a 5 p.m. stopover on flight daily from Los Angeles to New York scheduled to arrive at Kennedy at 12:45 a.m., starting Dec. 1. Service is designed to allow business people a full day in Los Angeles before returning to New York. Times given are local.**

► **Eastern Air Lines Dec. 15 will expand its Airbus service to include one flight daily between Boston, St. Petersburg and Miami. Traffic that for the route will be 375 to Boston St. Petersburg and 516 to Miami.**

► **Delta Airlines reports it flew 176,043 passengers during the third quarter of 1961—a 4.4% increase on the same period last year. Total operating expenses were \$2.6 million—including \$24,000 federal subsidy—for the third quarter of 1961 compared with \$2.7 million for the same period last year.**

► **J. K. Coates, assistant vice president research and planning for Southern Airways, has been named to head the airline's new Administrative Services Department.**

► **Northwest and Trans World Airlines have had the first between Oakland for the General Electric CJ 805 turbojet engines powering their Convair 440s increased to 1,440 hp. Delta Air Lines' TRG for the same engine-plane combination has been raised to 1,600 hp.**

► **Pan American World Airways has begun 40% reduction in stand-by fees between Europe and the U.S. for airlines personnel and their families. Fees will be in effect until Aug. 16, 1962. Sample reduction: New York/Philadelphia 5177, compared with 5501. Groups of 10 or more receive a 50% discount. Between the U.S. and Europe will get even greater reductions. Between Dec. 1 and Jan. 31, 1962.**

► **Rate reductions affecting the speed of aircraft may require new terminal zones in a domestic effort Dec. 18. Federal Aviation Agency announced that aircraft will have to operate in speeds of less than 240 kt within 30 mi of terminals when below 10,000 ft. Present rule is 230 kt within 30 mi below 14,500 ft.**

► **Seaboard World Airlines reports a net loss of \$531,000 for the third quarter this year. Loss compared with a \$115,000 loss for the same period last year. Total revenue for the third quarter was \$5.5 million compared with \$5.1 million in 1960.**

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AERONAUTICAL ENGINEERING

Breguet Flight-Testing NATO's Atlantic



BREGUET ATLANTIC cockpit has not yet had all equipment installed. The airframe's main structure is still only a prototype development program.



REAR ENGINE is attached and weapons bay open in photo above. Now in production version would be extended about three feet. This is the only major modification custom planned for production aircraft. Photo below shows open weapons bay and wing ribs for testing on upper members of wing and engine nacelles.



Versailles, France—Breguet 1150 Atlantic program for an anti-submarine warfare aircraft is expected to set the pattern for future joint weapons system development in NATO.

The big, four-engine turboprop aircraft plane first flew Oct. 21, 1968 ahead of schedule and less than one year after NATO ordered the first prototypes from Avions Breguet, the prime contractor.

NATO management of the program is through the six-nation Maritime Patrol Aircraft Steering Committee composed of single representatives from Belgium, France, West Germany, Holland and the United States. Permanent vice-chairmen of the committee are Henry G. Blois, head of NATO's armament section, and executive secretary of the committee is Lu Weyss, of the same section. Current chairman is Francis Nay, Cdr. Area Black, the position is a rotating one. Also on the national representatives on a scale of two-month terms.

Atlantic was designed and built by a group of seven companies in four European countries which have together financed the project with the help of the United States. Designed as a replacement for the aging Lockheed P2V Neptune, of which about 200 are operational with NATO forces, the Atlantic is still only a prototype development program and no production orders have been placed.

Breguet has scheduled first flight of the second prototype for next 11 months, and the third will follow one year later. Third and fourth prototypes will be pre-production models, with flight test modifications or any other needed changes incorporated. Almost plans have been made to lengthen the third prototype by about three feet. Fourth aircraft, which will be built to production standards, is scheduled to fly in May, 1969.

Atlantic has a high aspect ratio wing with a 175 ft. span and a total area of 1,291 sq. ft. Overall length of the aircraft is 92.7 ft. and the height is 33.4 ft. The leading fuselage has a double-bubble cross-section, with the upper lobe projected to house pilot compartment, tactical stations and crew quarters. Lower compartment will contain main compartment and two large bays. One of the bays is for detection, stream-projectable, nuclear bombs. The other is for weapons, including laser nuclear type. Additional air to surface missiles can be carried on wing pylons.

None of the nuclear gear comes from



DURING its sixth flight, the Breguet Atlantic flew with one engine inboard and French-designed CSF rotor installed.



WINGSPAN of Breguet Atlantic is 174.9 ft. Height of the aircraft is 33.4 ft., wheel track is 26.5 ft., fuselage width is 9.5 ft. and tail height is 131 ft. The two Rolls-Royce Turboprop RTY 30 Mk 21 turboprop engines come from Hindustan Type 4700B-6 turboelectric propulsion of 16-ft. diameter. Upper lobe of double-bubble fuselage is preformed.

the United States, but the high-power search radar and some other major installations are European.

Basic mission for the Atlantic is based on a 5,000-ton patrol range at a patrol speed of 170 kt. Mission time will vary from 12 to 18 hr. normally.

Maximum gross lift-off weight of the plane is 98,450 lb. Powerplants are two Rolls-Royce Turboprop RTY 30 Mk 21 turboprops rated at 6,945 shp each.

Aircraft production and design are the mutual responsibilities of a group of seven companies. Breguet, as prime

contractor, retained most fuselage design, final assembly, and flight testing of the Atlantic. The company also did the performance design that won the NATO competition at the end of 1955. But detailed structural design within the left envelope of the Atlantic's full-scale shape was left to each of the companies participating.

Other parts are the responsibility of Sud Aviation of France, while the wing center section and engine nacelles are made by Boller in Holland. Rear fuselage and tail are built by Dornier in Germany. Three Belgian companies—Avions Fairey, SAICA and the Fabrique Nationale d'Armes de Guerre—build the engine houses.

American firm was brought into the competition relatively after some requirements, making the NATO members found out about the program (AW Feb. 28, 1958, p. 18). None had time to make a careful analysis of specifications and prepare a proposal before the final deadline, then competitors tried, except for a limited effort by Martin Co. to be named without strategy.

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Magnetic Products Division 3M



RECENT PHOTO of North American X-15 moments before launch shows fuel streaming out of the jetport. *g/y* on the right side of the aircraft while liquid oxygen vents from the left pitot-static probe. This is done deliberately to make certain that pumps are operating properly before they. Note the proximity of the exhaust line engine to engine in the company of the X-15.

North American X-15 Research Program—Part II:

X-15 Contributes to Structures Research

By William S. Keel

(This is the second of two articles on the X-15 research program. The first article (AET May 20, p. 32) described such X-15 research, the vehicle's flight characteristics, control systems and flight profile.)

Edwards AFB, Calif.—Some of the planned X-15 research programs relate directly to the next generation of aerospace craft, among them the supersonic transport. Investigations of boundary layer noise and skin friction drag structural panel tests, and the use of adaptive control systems are among these programs.

X-15 data on boundary layer noise and vibration requirements will have direct application to the supersonic transport. Boundary layer noise extractions are to be installed at several locations on the side fairing of the airplane. The investigation will consist of a comparison of the local noise intensity

with the measured boundary layer conditions.

Predictions of lifting-surface characteristics and the resulting drag coefficient of a particular configuration early in the design stage will also be of vital interest to the airplane designer. Although less drag measurements on the X-15 have compared favorably with the wind tunnel predictions, the total drag calculated from flight data was more than that predicted from wind tunnel tests. In an attempt to understand better the cause of this disagreement, skin friction drag measurements are to be made to determine the effects of the skin friction components on the total drag.

Future plans also call for obtaining the lower vertical fin and side fairing panels as test bed locations for various types of skin construction to determine applicability to the supersonic transport. Provisions are being made for the installation of movable and replaceable

panels in these areas. Structural configurations such as honeycomb materials will be installed and instrumented for quasi-static and temperature distribution tests.

Prior to the first launch of the X-15, considerable wind tunnel testing had been directed toward determining the effects of the B-52 deployment on the X-15. Previous market research craft had been launched from the launch bay of B-52 or B-58 aircraft and from this position they experienced tail area control as flow in the B-52/B-58 configuration. The asymmetric position of the aircraft under the B-52's right wing led to some concern regarding controllability during drag. It was suspected that the upper vertical fin of the X-15 might possibly contact the edges of the control in the B-52 bay.

During launch from the first powered glide flight, the X-15 separated cleanly and experienced the predicted right roll and nose-down pitch. During sub-



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instead of making them"**

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quent inadvertent drops, it was noted that the aircraft tended to pitch down and roll to the right more strongly with the peak roll rate occurring in 12 deg/sec.

With the roll damper operating, however, the maximum right bank angle was held to 9 deg. *Low's* second damper operation on some flights was a more critical operation. During one flight, the X-15 achieved a maximum right bank angle of 40 deg before recovery could be effected when the roll damper cut augmentation. Control positions held by the pilot at launch were also. However, the input of left aileron control prior to launch eliminated that rolling tendency. Facilitating the control at 6 to 8 deg left aileron means reducing the rolling tendency of the aircraft during the 8 sec which was required for the aircraft to assume and hold the angle of the aerodynamic effect of the full deflection.

The right bank angle can be kept to within 20 deg without damper operation at an input of 6 to 8 deg left aileron as applied before launch. Zero aileron position results in a peak rolling rate of 47 deg/sec to the right.

Another problem, which had to do with left damper cut was the nose effect of the B-57's number 5 engine at cut engines on the X-15, X-15 Project Man age J. E. Love of NASA said that it became necessary to increase the pitch horizontal and yaw the control of the X-15 to withstand nose up movement of the engine while the two aircraft were mated. Nose effects had been to cause slight curvature in the radar and elevation of the X-15.

Very little reaction is experienced by



PHYSIOLOGICAL DATA taken during an X-15 flight shows the effects various flight portions have on heart and respiration rate. Prior to launch, respiration rate is about 15 breaths/min and heart rate is 120 beats/min compared with 16 breaths/min and 80 beats/min for an individual doing moderate work at a sitting position. Physiological readings show a peak at engine burn out, start of zero-g and at landing. The two bars on the order of short represent acceleration forces, g , for manual g and g for instrument g . Lower line h is pressure altitude and M for Mach number.



METHOD in which variable stability, T-33 simulates X-15 entry is illustrated by chart showing that a light rise is calculated for an X-15 pilot. Instruments on the T-33 are computer-driven so that training pilot on fixed seat does not know he is training.

the B-57 as the X-15 drops zero, primarily because of the disparity in the gross weights of the two aircraft. Love points out.

Weight of the X-15/B-57 combination at altitude is about 100,000 lb. At launch the combined weight is approximately 201,000 lb, of which 14,000 lb is represented by the weight of the X-15. The B-57 operates in a trim condition prior to launch because of a deliberate aerodynamic fuel condition. Much fuel is carried in the left wing due to the right, compensating for the X-15 weight. Much tests position of the B-57 pilot's operation at operating the aircraft for landing and takeoff without wing flaps.

Present engine running time with the X-15 engine, is between 70 and 80 sec of full power. This can be increased somewhat at the expense of some safety factor, Love disclosed. For instance, prior to launch, the liquid oxygen pump operates for 10 sec. to ensure there will be no difficulty in starting the engine. Also, the engine pump is still for 10 sec., pumping fuel discharged to ensure engine operation after launch.

Analysis of structural testing on the X-15 wing shows that at relatively low speeds, Mach 1, maximum heating on the wing on the lower side of the wing at the 17% chord point. Wing leading edge temperature is much lower at the low speed, but becomes higher as the speed increases.

Minimum temperatures exceeding 1,400°F have been recorded on the wing tip during hypersonic flight.

Of even greater concern than the low temperature is the effect of temperature gradients on the internal structure of the aircraft. Thermocouples at the midpoint of the wing show that when peak g and temperature are approximately 4 g 's, temperature is approximately 4 g 's. For thermocouples, dissimilarity in the skin surface, and relatively sharp patches can have large

effects on temperature. Temperature-sensitive paints have been applied to local areas on the X-15 to illustrate graphically how these phenomena affect skin heating. The backup structure beneath the skin acts as a heat sink and draws away heat, keeping the skin cooler in these areas, whereas composite skin areas are free to heat up.

In particular, heat buildup to a maximum on the leading edge of the wing where equipment ports in the leading edge are located. Because of the high temperatures which have been encountered in these areas, inter-sheet buckling of the skin immediately behind several of the equipment ports has been found. The wing leading edge has been modified to incorporate fittings where the equipment ports are located to eliminate the heat buildup in these areas. A photograph of the temperature sensitive paint shows graphically where internal stresses such as a heat sink or a heat sink area exist in built up or joint leading edge discontinuities.

Panel flutter is of concern on some of the thin unsupported skin areas on the X-15 fuselage. Considerable effort is being expended to predict panel flutter. The B-57 operates in a trim condition to determine the influence of temperature, low angles, and panel effect on skin. Strain gauges mounted on a fuselage side fitting showed a large increase in strain at the position of the skin of about 600 psi and a Mach number of approximately 2.5. The panel is stiffened with elongations inserted perpendicular to the airframe and attached to the interframes. To correct this, "bar" section struts were reworked to the main compressions mounted in the direction of the airframe.

Subsequent tests on the panels which were allowed by the "bar" section gave good results in reducing the flutter. Also, an evidence of flutter. Considerable interest in panel flutter has been generated by X-15 flight tests in one sense because of the aircraft program.

Stability augmentation systems on the X-15 have generated two problems, the first being a control oscillation, at least cyclic, resulting from free play in the control system and the second being a structural oscillation in the system integration. The first has caused undesirable low frequency oscillation of the airplane at high system gain settings and high control effectiveness.

The airplane transient from the first cyclic has been found to be unacceptable by the pilots, however. The second problem has caused violent oscillations of the aircraft in flight with high roll-rate settings. These oscillations have been found to be unacceptable by the pilots, however. The second structural feedback problem, a caused by rapid control surface deflec-

tions which create vibrations in the control surface structure at the natural frequency of the surface. These oscillations are low-damped and are excited by the rate gain in the augmentation system which, in turn, feed the signals back into the control system. This produces a violent oscillation of the entire airplane occurring at the natural structural frequency of the control surface.

To prevent the occurrence of this phenomenon, close attention is required in placement of rate gains in the feedback so that they are least sensitive to structural vibration.

Filters Used

Altitude filters in the augmentation system are introduced to reduce gain at the structural frequencies which could induce large vibrations in the system. Experience to date, although generally satisfactory, emphasizes the necessity of close inspection of sensing operations and well-planned checkout techniques in the augmentation system because of a number of failures.

Slightly less than one-third of the flights have been flown with various sets of the stability augmentation system either completely inoperative or inoperative. And in some cases, flights were undertaken even though the augmentation system was known to be malfunctioning prior to flight. Failures were found to be caused by a variety of electrical wiring problems with additional failures in the electronic package, as in the manual power setting switch assembly.

The X-15 has experienced a number of cabin pressure failures during recent high altitude flights. The emergency descent system for the aircraft utilizes radiation as partial protection against high temperatures. This system is again being supplied by a temperature sensed system to control temperature and pressure in the pilot's compartment and in the electronic equipment bay. As an integration of the failure occurred that the cabin oxygen temperature, especially in the case of the temperature control valve, fell so low during parachute operations that the descent for additional legal attempts to survive through specific requirements was lower than predicted. Thus, the additional oxygen ratings previously called for to assure and maintain a cockpit altitude at the specified value of 15,000 ft was not available.

This problem is being eliminated by providing a supplemental pressure control means of injecting liquid nitrogen into the cockpit.

Several forms of vibration have long been used in the X-15 program, primarily aimed at familiarizing the pilots with the zero-g characteristics and



First Belgian F-104G Flight-Tested

ten Lockheed F-104G fighter jets for Belgium at this the only one to be produced and tested at Lockheed's Fort Worth, Texas, plant. Lockheed's first F-104G was assembled by the Belgians. Aircraft shown here landing down at Flanders will be delivered to Belgium next month. The first Belgian-manufactured F-104G is expected to be completed in early 1962.

landing performance of the X-15. Because flight duration is very short, usually on the order of 10 min, one valuable effort has been expended in building simulators for use in training tools.

One such simulator is a control system and cockpit module at the North American Aviation plant in Inglewood. Control system movements are fed into a computer which integrates these inputs and then feeds the cockpit receiver means to simulate a complete X-15 flight from launch to landing (AWC Oct. 17, 1960, cont.)

Other Simulators

Two other simulators have been used to augment pilots with stability and control effectiveness in certain flight regimes, principally the zero-g portion of the flight. Two aircraft have been used for the X-15 control T-33 and a North American F-104.

T-33, modified by Cornell Aeronautical Laboratory, features variable stability which can be changed to simulate the X-15's stability characteristics and maneuverability and effectiveness in the X-15. Either a selected condition or the control stick can be altered by the evaluation pilot in a front cockpit. These controls feed signals to sensors through a computer system which then feeds the stability of the T-33 to make it handle like the X-15.

One example of such a mission is to simulate the zero-g portion of the X-15.

To start the T-33 does to maximum permissible speed before pulling up to a 45 deg angle. The aircraft then is pulled into a zero-g and variable response is established. At this point the safety pilot in the rear seat engages the speed control system, transfer control of the airplane to the X-15 pilot in

the front cockpit and starts the program.

The X-15 pilot flies takes control and rotates the airplane until the angle of attack developed to have agree with the specified zero-g angle of attack of the X-15. The T-33 load factor is increased during the rotation. In the case of an X-15-0.2 g . Proper relationship between the developed angle of attack and load factor is maintained in the program.

Reference motion, outside the cockpit is observed from the evaluation pilot in a front cockpit. Following the prescribed angle of attack and normal accelerations scheduled for zero-g with wing level on the display instrument, he will automatically keep the T-33 on the specified speed altitude relationship. A final turn in the T-33 simulates the last portion in the latter part of the X-15 mission. The X-15 pilot thinks he is performing a winged pull-out while in reality he is in a steep bank to maintain the proper g load. This is done to slacken pressure the attitude prior to the pilot's exit from the zero-g.

Control System Response

F100 Super Sabre also is used by the X-15 pilots to reproduce the control system response of the X-15. This aircraft also features a variable stability control system which is the nearest related to the Cornell T-33 but it is a single place aircraft.

Perhaps the most useful tool for simulating is the Lockheed F-104 in which the X-15 pilots have been programmed leading patterns. By practicing simulated flight sequences with the F-104 the pilots acquire proficiency and occasionally refresh their leading techniques. It is perhaps through the use of the F-104 that pilots have been able



OFFICIAL U.S. AIR FORCE PHOTOGRAPH

NICE CATCH!

This F-105 is participating in one of a series of tests of the BAK-9 overrun barrier installation at Seymour Johnson Air Force Base, Goldsboro, North Carolina.

As a matter of fact this particular barrier has already figured in a previous emergency: an F-105 came in on a "deferred emergency" and its drag chute failed to deploy. But, despite the fact that the aircraft was unusually heavy with fuel, an engagement twenty feet off-center with the BAK-9 brought it to a safe, smooth stop within the overrun area.

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to land the X-15 with such provable accuracy. In the final analysis, however, it is the actual practice with the X-15 that leads to perfection. The seventh test in the simulation program, T-104, F-100 and T-13 as all valuable tools because dynamic response is variable.

USAF Support

Air Force Test Center's support of the X-15 flights was supplied much in a matter of routine but still crucial parts a significant effort. For a typical flight such as those recently made, an explanation of the performance envelope, Air Force X-15 Flight Test Project Officer Richard J. Hines points out some of the personnel and equipment involved.

• **Support aircraft.** In addition to the X-15 and B-12, 10 other aircraft with crews are assigned for each mission. One F-104D, two F-105As and one F-106F fly chase during the flight duration of the mission, two C-130As, one C-54 and three B-21s for equipment and personnel transport and rescue. One C-47D and the H-21s are airborne in the vicinity of the emergency landing zone with a dash about one H-21 and two personnel aboard the C-119. These orbit points are such that they are no further than ten minutes from the scene of a crash.

• **Support vehicles.** Five trucks are located at the launch point, two intermediate bases and at Edwards. The five trucks at each launch site are not added to the company until the day before the flight. Total number usually is two at launch site, one at each intermediate site and two at Edwards. Other equipment is provided in the form of emergency trucks and radio equipped vehicles.

• **Support personnel.** The launch unit numbered by a total of 24 persons NASA and the Air Force also provide X-15 specialists and crew chiefs at all sites plus personnel and specialists to assist the pilot.

Contact must be maintained between the various vehicles and usually at the emergency site and all must be in position by launch time. Should one fail to be ready at the proper time, side effects may be in the way of an emergency shutdown at the last minute.

One example of last minute vehicle system took place on the altitude flight mark in which the F-105A (John B. McKay) was scheduled to fly an F-104 chase aircraft but mechanical difficulties developed at the last moment and he was unable to take off as planned. He went to the NASA hangar where an A-10 was ready and he rode a takeoff runway on the day. His own contacts behind his original vehicle McKay managed to shift into position with no time to spare at the proper point.

Coordination also must be maintained with the Federal Aviation Agency, Hines says, to provide interference among the X-15 and support aircraft and one in traffic along V-13 airway. This is sometimes difficult especially when delays cause the expected takeoff time to slip. In addition, all local traffic flow Edwards and support fields must be kept out of the area to minimize interference with those aircraft in the X-15 field. Warning also must be provided to adjacent U.S. Army Nike sites where search and tracking radar come interference with the daylight mission pass above the B-52 making precise location of the launch spot quite difficult.

PRODUCTION BRIEFING

Halliburton Co. of Chicago will provide communications equipment for Boeing B-52 bombers under two Air Force contracts totaling more than \$8.5 million.

United Electronics, Inc., Pasadena, Calif., will contract a scientist observer on Titan National Forest, 90 mi. southeast of Phoenix, as part of Forest Volo, under direction of the Advanced Research Projects Agency of the Department of Defense. The observer is intended to provide improved means of detecting and identifying

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B-58's Electronic Countermeasures Housed in Belly

New electronic radome on belly of Convair B-58 houses part of bomber's electronic countermeasures system designed and produced by the Radio Operations Systems Electronics System. The radome is designed to withstand 11g during flight, and temperatures from zero to 315°F. B-58 weapons pod in background can carry a nuclear weapon.

ing nuclear explosion for possible use in an interdicted system of nuclear fuel control. Air Force Technical Application Center is technical supervisor.

Boris Products, Pasadena, Calif., will supply Lockheed-California Co. with control booster assemblies for the PTU-4 Orion under a contract costing \$750,000.

Aviastar, Inc., recently received successfully a 1,500-hp thrust rocket engine proposed in a seven-year fuel control and stabilization of the Apollo spacecraft. The design was a development test area took place at Aviastar's new Space Test Area at the Goddard Space Center, Md. The engine is part of the Apollo program and is used in the Apollo program and is used in the Apollo program.

General Electric, St. Louis, Mo., will supply electrical and electronic control systems for the B-58 bomber. The systems will be used in the B-58 bomber and will be used in the B-58 bomber.

IBM invitations have been issued for an estimated \$1.75 million in addition to the Convair and Control Division Laboratory at National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala. The program is part of the Apollo program and is used in the Apollo program.



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Future Weapon Choice Problems Analyzed

By David A. Anderson

New York—With more than 30 different systems for missile delivery now either operational or in development, choice of future weapons is added to the list as an exciting and difficult problem, Prof. Charles F. Perkins of Princeton University said.

Perkins, who is chairman of the Department of Aeronautical Engineering, Princeton University and most recently has been assistant secretary of the Air Force for research and development, spoke at a past meeting of the New York section of the American Rocket Society and the Institute of the Aero Space Sciences.

He added his comments to the serious struggle of publicly voiced dissatisfaction with current policies and procedures for weapon system procurement (AW Oct. 9, p. 20).

He said the toughest problem was the fast change of the system which had to be pulled from its state as test data others, and had to be pulled into account future missions, the instability of cost and program objectives, and the uncertainty of more other factors of future a final decision. "Working under a fixed budget doesn't help the decision either," he added.

Six Steps to Selection

Perkins delineated six steps that introduce between the requirement stage and final choice of a weapon system. He pointed out that some of these had a single approach as a single solution, and that in several cases there is a multiplicity of possible answers to the question posed.

First of the steps was the problem of meeting the requirement rules to the state of the art at issue future time. Perkins said there has always been confusion between operational people on one hand and research and development types on the other that can be significantly fixed to determine requirements. "Right now the top rule is quite an operation," said Perkins. "And so operations are being written in the office of the DCS/D [Deputy Chief of Staff/Operations]."

Current and classic example of an airplane weapon system whose requirements called for future state-of-the-art advances was the Convair F-59 Bomber. When the requirement was first defined, it was well ahead of contemporary engineering. Later in the development life, such advances as the zero lift and constant chamber caught up with

the development ends, and made the final form of the F-59 possible, Perkins said.

He also cited the USAF requirement for Aerospace Plane as one area where presently new concepts are not being developed in advance in technology. The concept looks like now as an R&D project, he said, but it's too early to start writing the requirements around the idea.

Second of the steps is in system selection is the choice of the way to run the research and development program over it is funded. Here the basic choice is between full autonomy of development and the old traditional prototype-to-production chain.

Builder Competition

Example cited was the first post war bomber competition which produced the North American B-45, Convair B-46, Boeing B-47 and Martin B-48. Prototypes were built of each, they were test flown and evaluated, and final orders for the B-45 and B-47 were placed. Finally the big order went to the Boeing order.

And over some time, said Perkins, "people have been using that program

as an example of how not to get anything done."

Maybe it isn't, he added, but there doesn't seem to be a good proof one way or the other. The bomber in construction as if the weapon system isn't as good. The bomber in prototype development is time in the cycle. Furthermore, full autonomy is tremendously expensive, he said.

National Survival

Perkins concluded that autonomy was worthwhile when—and only when—national survival was at stake. Atlas, Titan, Minuteman and Polaris developed in accordance with all their supporting and auxiliary systems, was necessarily done that way because of their importance to survival, he said.

"But it doesn't necessarily follow that you should do everything this way," Perkins stated.

For example, he pointed to the Nike Zeus automatic missile system. He said it was certainly necessary to construct a national missile defense in the system was going to be an enormous task that might be worthwhile to wait a little more to see if it has a chance of working before



Zero Gravity Maneuvering Bolt Tested

An F-4 Phantom II test in the calm air in an Air Force C-119, during zero gravity test of Full Autonomy Aero Zero Gravity Bolt. Bolt is designed to allow occupants of manned space vehicles to have a taste of maneuvering when they leave the spacecraft for inspection, repair or assembly tasks. Maneuver gas under pressure has 20 lb. thrust.

concocting billions of dollars to full prototype.

Availability of both costs and program objectives is the third major hurdle in the selection of a system, Perkins said. "Earlier we don't know how to cost it as we are now finding to face the real costs of a full system development."

As one case of low cost contractor climate with time, he cited the Douglas Skybolt program as the "most successful example of success." Douglas was low bidder for the B-61 program with \$120 million, he said, but within a short time after the award of the contract, Air Force Air Research and Development Command said that the program actually would cost about \$240 million. Perkins said that such escalation around in the Pentagon produced the necessary money at the expense of other development.

"That about the time we got that fixed," he said, "the Air Force came back with a 'definitized' contract and they said it wasn't going to cost \$120 million, or even \$240 million, but \$170 million."

Perkins pointed out that Skybolt would argue the value of Skybolt as a weapon system, in general with its concept as design. But he did want to emphasize the kind of cost stretching that went on.

Fourth item on Perkins' list was the problem of keeping a program alive. In previous times, was the first of main factors he based on during an important role. If the Air Force wants something, the Army and Navy are automatically against it," he said. "It works in all directions. The Air Force keeps referring to Perkins as 'that 30-year man'."

Influence of the long contracts is not negligible in a program's chances for success at Perkins pointed out, saying that if you need a development contract to one of five contractors, the other four are in your office the next day saying that it was a long idea in the first place. "They maintain the only real reason they had in the first place was because we wanted them out."

Perkins said that during his tenure in the Office of the Secretary of the Air Force, he was frequently applied by the post office at engineering school to various levels in the Pentagon. "The corridors are full of people with flycatchers," he said, "and some of them are going to lead the wrong way."

At one point in the life cycle of the North American B-70, Perkins said, the key man on the project was former Air Force Secretary Douglas Skyles, a banker with keen appreciation of cost, but weak on the technical side. North American wanted a replacement in a 175 building to Skyles and Perkins arranged it, emphasizing the time against getting too far into technical problems.

To his amazement, the North American

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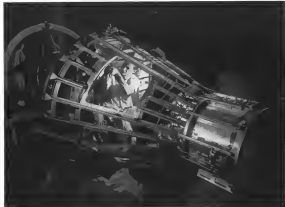
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ten capsules spent the first 30 minutes of their landing falling. Shown how difficult it was to make the main launch and recovery capsules in the B-70 structure, and about all the effort the company was expending to build, but still assemble these even so-called "When the team later asked Perkins for an expression of their discomfort as selling Shupe he told them they had actually convinced Shupe that it was very difficult and very expensive to make stainless steel and weld.

Perkins said there was particular concern about the way to handle the number of scientific advisors. The problem, often on the list, was the direct result of the large number of scientific advisors attached to government agencies starting at the top with the President's Scientific Advisory and the Scientific Advisory Board, Perkins cited some of the other groups: Director of Defense Research and Engineering, Defense Science Board, Air Force Scientific Advisory Board, plus the Navy and Army equivalents, advisors for all congressional committees concerned with defense, and even advisors to the Bureau of Budget.

The real problem, said Perkins, "is that these scientists are very often asked to give scientific advice. Instead, they want to advise on operations. I don't know why, but scientists love to talk about strategy."

Finally, with all these previous handouts out of the way, the final and highest and most serious how to make the choice of a system.

Perkins said there are members of who to partly the choice, once it has been made. Cost effectiveness, operational analysis, special competence in a field all play a part. But there are pitfalls. Cost effectiveness studies can be neglected to give the desired result by judicious choice of assumptions. Operational considerations may tend to favor one system for as long as those considerations remain unknown by the other competing system. As soon as they find out, they also claim the same competence and can show drawings or figures to prove it.

There's no easy way to make the choice, Perkins concluded. With its enormous complexity and cost of system development, the factors affecting choice increase out of all proportion. Furthermore, the recent concept of a fixed budget has done nothing to make the situation any easier.

Perkins quoted Gen. Thomas D. White, former USAF chief, who said once that if the trend continues, he can foresee a day when there will be only enough money to fund and development program in the budget. Or, said White facetiously, maybe one can only one study program.



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U.S. Aeronautical Exports to So. America Show Sharp Rise in 1960

Washington—U. S. exports of aircraft and parts to South America totaled \$15 million in 1960, a sharp increase over 1959 and possibly the start of an upward swing in the export pattern.

Latest figures compiled by the Commerce Department's Bureau and Defense Services Administration show U. S. companies exported aircraft valued at \$29,197,955 and parts and accessories valued at \$1,693,997 in 1960 for a total of \$30,891,952. This compares with totals of \$19,336,231 for 1959 and \$48,664,376 for 1958.

Commerce Department officials believe the light aircraft market is the most promising one in South America, noting that over two-thirds bought 514 aircraft in 1960 which carried four or more passengers but weighed less than 6,000 lb. (single-engine weight). This was the largest number produced in any category.

The DASA report on South American civil aviation will be published later this year in study form. It is one in a series of civil aviation studies through out the world. Export figures shown below figured heavily in the Administration's forecasts on the market potential in South America.

(In Dollars)

	1958		1959		1960	
	Number	Value	Number	Value	Number	Value
Passenger Transport, Commercial, New, 2,000-14,999 lb.	16	1,586,431	8	147,547	14	1,407,847
Colombia	1	41,200				
Brazil	4	508,558	3	147,547	6	617,710
Venezuela	3	214,548			1	100,417
Bolivia	2	387,500				
Chile	3	331,690			1	76,157
Argentina	4	305,497			1	99,443
Peru					3	156,000
Uruguay					1	107,700
12,000-19,999 lb.	7	4,407,432				
Venezuela	3	2,061,261				
Brazil	3	1,336,170				
20,000 lb. and over	10	31,534,394	4	4,233,790	3	11,318,619
Peru	1	1,300,000				
Brazil	9	11,511,304	4	4,233,790	3	11,318,619
Chile	4	2,778,288				
Argentina	3	4,034,794				
Binary Wing, Commercial, New					2	375,880
Brazil	1	37,730				
Chile	1	174,718				
Argentina					1	37,432
					1	107,330
Commercial and Civilian Aircraft, Used and Refurb, including Conversion	53	11,318,481	58	4,337,561	47	7,816,739
Colombia	3	146,000	10	1,429,937		
Venezuela	4	1,060,000	7	1,020,547	7	1,020,547
Peru	4	400,000	1	99,720		
Chile	3	607,707	7	1,010,000	3	400,749
Brazil	10	1,747,000	9	1,010,000	8	716,370
Peru	1	8,000	3	122,000		
Argentina	10	944,200	12	1,940,000	10	2,800,000
Bolivia	4	161,000			3	620,000
Brazil	4	600,000			4	610,000
Under 2,000 lb. 10/10s, Commercial/Civilian, New 8 Places and Under	39	328,772	115	1,013,547	83	703,815
Colombia	14	126,500	44	428,234	31	304,610
Venezuela	4	30,300	3	20,470	9	41,014
Brazil	4	64,000	6	36,363	14	134,340
Peru	1	5,000	10	43,423	3	17,000
Chile	1	3,700	3	20,303	7	49,507
Brazil	1	4,574	3	36,139		
Peru	2	13,400	4	23,400		
Uruguay	2	18,000	2	18,000		
Argentina					3	47,400
Bolivia	3	47,100	20	167,171	26	261,241
					2	37,730

	1958		1959		1960	
	Number	Value	Number	Value	Number	Value
4 Place and over	142	2,432,871	120	2,037,231	224	3,797,300
Colombia	6	134,880	12	143,294	5	101,131
Venezuela	15	343,890	19	248,200	32	248,200
Brazil	1	30,000	1	13,000	5	43,201
Bolivia	1	16,000	3	61,000	4	126,147
Chile	5	74,772	3	68,294	3	43,495
Chile	4	12,264	3	67,454	23	360,912
Brazil	12	774,314	38	404,483	53	1,289,141
Peru	67	249,429	7	101,219	5	124,204
Uruguay	3	26,140	7	137,153	13	251,433
Argentina	31	508,190	47	640,313	148	2,114,584
Binary Wing, Commercial, New	7	123,132	7	123,132	22	371,210,487
Argentina					1	49,728
Chile					1	102,480
Bolivia			1	37,200	1	2,640
Colombia						
Venezuela	3	126,880	6	248,230		
Brazil	5	124,000	2	132,248	13	843,472
					1	68,207
Other New Commercial and Civilian Aircraft	1	205,500	2	37,007,300		
Brazil						
Bolivia	1	80,000	2	3,107,300		
Commercial and Civilian Aircraft, Used and Refurb, including Conversion	48	477,810	34	207,200	41	1,074,124
Peru	1	14,200				
Colombia	4	121,000	3	23,220	4	131,340
Venezuela	4	16,840	4	24,630	2	17,000
Brazil	3	47,200	3	53,200	9	187,134
Bolivia	4	25,740	4	35,740	2	26,750
Chile	6	37,140	3	2,000		
Brazil	5	34,000	2	20,200	4	56,000
Peru	1	20,000	1	32,000	2	34,000
Argentina	30	116,400	4	29,760	2	37,200
Peru	1	1,000			12	91,640
Total Aircraft	339	\$46,145,904	348	\$10,146,711	338	\$81,167,748
Parts and Accessories, Aircraft Engines, Refurbishing, New Aircraft under 400 lb.	330	\$171,412	215	\$333,311	246	\$649,840
Colombia	11	35,170	37	46,170	16	61,369
Venezuela	14	47,440	10	47,270	21	61,338
Brazil	11	36,514	13	24,219	12	27,312
Peru	9	4,890	6	11,800	8	18,320
Bolivia	14	70,341	2	5,619	5	16,240
Chile	12	21,742	19	65,794	6	15,740
Brazil	17	20,613	70	144,440	77	201,944
Peru	3	37,274	4	14,074	2	8,841
Uruguay	9	6,459	1	1,467	2	5,718
Argentina	44	131,376	37	97,410	40	167,814
Aircraft Engines, Refurbishing, Used and Refurb	472	\$2,616,648	343	\$1,610,120	229	\$2,812,137
Colombia	74	320,414	77	449,347	173	505,430
Venezuela	124	1,645,811	77	425,876	96	377,294
Brazil	40	70,138	20	27,319	14	48,271
Peru	43	192,072	20	112,100	54	137,159
Bolivia	12	49,500	46	184,674	28	212,126
Chile	10	122,143	9	49,330	13	60,113
Brazil	121	746,344	70	345,170	140	1,044,000
Peru	6	14,100	1	2,000	4	32,880
Uruguay	36	44,330	6	20,200	6	25,667
Argentina	33	195,240	20	86,270	63	272,123
Total Parts, Accessories	723	\$3,106,472	274	\$3,163,208	776	\$4,474,267
Grand Total (Aircraft, parts, accessories)	1,062	\$49,252,376	622	\$13,309,919	1,114	\$85,641,015

Note: All weights are empty airframe weights.

Parts are not included because data by country are not available in many items of components, parts and accessories.

DIVERSIFICATION...

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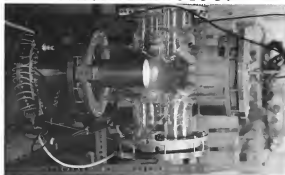
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MILITARY EQUIPMENT DIVISION — DETROIT 32, MICH.

MISSILE PRODUCTS DIVISION — LOS ANGELES 58, CALIF.

SPACE TECHNOLOGY



COAXIAL PLASMA GUN being studied by General Dynamics/Astronautics for NASA. It basically has two cylinders, one within the other. Gas introduced in the smaller space between cylinders and an arc discharge creates a magnetic pressure wave, pushing gas ahead of it.

Major Space Role Seen for Plasma Engine

By George Alexander

Magnetohydrodynamic engines will be the major contender among electric powerplants to meet long-range propulsion requirements of space vehicles through the 1970s, according to Dr. R. Schwartz, acting chief of National Aeronautics and Space Administration's Space Propulsion Office.

Schwartz told *Aviation Week* that "a consensus of opinion seems to exist among the spacecraft people that the specific impulse usage between 1,000 and 5,000 sec⁻¹ will be required of near-weathered space vehicle powerplants over the next 20 years."

Magnetohydrodynamic (MHD) engines, which basically develop thrust from the interaction of a plasma in areas of magnetic fields, are the only type that can fulfill the requirement adequately, Schwartz said. Since this propulsive bandwidth falls between the upper limit of jet engines and the lower limit of ion engines.

The NASA space propulsion chief said that while jet engines should be ready for flight testing in 1965, "and gas-turbine is being made with MHD seeds and we should be ready in

1965 or 1967." Experimental flight tests of both MHD and ion engines, using conventional batteries, could be made around 1968, he said.

Schwartz said that in these applications, MHD, ion and jet engines are complementary and not competitive systems. "It is an early conclusion, but more than likely," Schwartz said, "that a spacecraft will combine conventional, or also those, types of electric engines for different purposes." The jet would be used mainly for station keeping and attitude control, he said, while the ion and MHD units would be used in great propulsion systems. Mission requirements probably would dictate a choice between them, Schwartz explained.

Thrust range of operational ion engines is expected to be between 0.01 to 0.5 lb. with specific impulses of 5,000 to 10,000 sec. MHD engines should deliver between 0.05 to 1 lb. thrust, with specific impulses ranging from 700 to 10,000 sec. An jet will produce from 0.1 to 1 lb. thrust, but with a specific impulse of only 700 to 1,900 sec., Schwartz said.

The potential of both ion and MHD

engines is greater than 10,000 sec., Schwartz stated. If the present limitations of high temperature materials and lighter weight means compact nuclear power sources are resolved.

Taking these parameters into consideration, Schwartz said that it would be unlikely that an ion engine would be chosen to power a manned spacecraft on a 10-day deep space exploration when an MHD unit could set the flight time "by approximately one half." But where lower thrust levels and longer flight times were acceptable, he added, such as in an unmanned probe, an ion engine would be satisfactory.

Other advantages of MHD engines over ion units, Schwartz said, include the following:

• **Greater pulsed capability.** Because the specific thrust of the MHD system is greater than that of the ion engine.

• **Lower complexity.** MHD designs have no complicated, although not presently an accomplished feat, could be achieved within the development of the former system. Reliability is also expected to be higher for MHD engines. • **Absence of exhaust contamination and electrode erosion problem in MHD**



Raytheon brings proven guidance and

Three techniques are currently available to meet the challenge of Space Rendezvous Guidance: radar, infra-red and optics. Of these techniques, radar has been used for bombing guidance systems to the greatest degree. Studies by Raytheon, whose radar experience spans three decades, have indicated that continuous wave radar possesses three desirable characteristics:

- No minimum or 'blind' range
- Direct and accurate velocity readings
- Greater range for a given weight
- Ease of acquisition
- Simple FM Techniques for ranging
- Greater simplicity and reliability

sensor capability to space rendezvous

The experience gained from the inertial guidance system for the advanced Polaris, coupled with the proven success of the Hawk and Sparrow C W homing systems give Raytheon the most extensive proven capability applicable to the space rendezvous guidance problem.

In addition, Raytheon, one of the world's largest scientific-industrial organizations, has proven its ability to manage every phase of a complex system — from early study and design through development, production and field support of operational systems and equipment.

Missile and Space Division, Bedford, Massachusetts

RAYTHEON COMPANY

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FROM TASK — THREE NEW DIELECTRIC COOLANT PUMPS

Three unique design concepts used in Task's DC-70 pumps to meet the operational requirements for their main line. Reductive were applied using design provides the simplicity of surface construction without the using valves and changing from controls to the integrated design. Reductive performance is enhanced by utilizing an integral motor. A novel internal load system reduces operational performance when research groups. Variation that of the task pump pressure. Combined with novel design and control mechanisms, these reductive result in exceptionally low power.

For further details on Task's dielectric coolant pumps, please contact: 6-2100 in water. Task Corporation, 2000 E. Westfield Ave., Anaheim, California.



PN 570-2
120-00-00-104



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120-00-00-105

Task Corp.

USAF Life Sciences Shift Is Due Jan. 1

Washington—Air Force has decided to shift biotechnology research to the Systems Command in two steps. It is completed Jan. 1, 1965, biotech research activities problems prohibited the transfer in Oct. 1 as originally planned (AV Sept. 25, p. 75).

Brig. Gen. Theodore Redford, Jr., assistant commander of the new-established Aerospace Medical Division in SMC. This new division will have major operating divisions in AFSC, and consists of the Aerospace Medical Center at Brooks AFB, Texas, and the Active Aerospace Laboratories at Fort Wainwright, Alaska. Both facilities were transferred to AFSC from Air Training Command.

Elements of the Aerospace Medical Center involved in the transfer are the School of Aerospace Medicine, the Lockheed AFB Hospital, 6570th Endo-physiology Laboratory at Lackland, the 6570th Air Base Group at Brooks, French, under the Aerospace Medical Center, and working with the Training Command, at the Medical Research School at Center AFB, Ala.

On Dec. 11, the Aerospace Medical Center will be disbanded, and the Aerospace Medical Division will consist of eight major organizational elements. They will be the School of Aerospace Medicine and the 6570th Air Base Group at Brooks, Lackland AFB Hospital, French Laboratory and 6570th Endo-physiology Laboratory at Lackland, Aerospace Medical Laboratory at Wright-Patterson AFB, Anatomical Field Laboratory at Hurler AFB, and the Active Aerospace Laboratory at Wainwright.

Other elements in AFSC are Space Systems, Ballistic Systems, Astronautical Systems, Electronic Systems and Foreign Technology.

Thermoelectric Alloy Effective at 900C

Communications alloy, which offers important advantages in a thermoelectric material has been developed at RCA's David Sarnoff Research Center under a research program headed by Navy's Bureau of Ships.

RCA says the new material is most effective in the temperature range between 500C and 900C; those figures include the temperatures of such heat output from turbine engines (about 500C) and gas flames (about 900C). Advantages over currently used lead telluride thermoelectric materials include higher power density—about four times that of the one—better stability—and stability at high temperatures.

FINANCIAL Raytheon Expects Slower Growth Rate

By James D. Hendricks

New York—Annual growth rate of 7% to 8% during the 1960s, slowing considerably from the pace of the last 10 years, will limit a total electronic volume between \$10 and \$12 billion in 1970, Richard E. Krut, president of the Northern Co., predicts.

Total government 1961 spending on electronic equipment will reach \$7 billion, including related non-electronic waste and space expenditures, Krut believes. In 1970, he estimates government electronics spending at \$10 billion and another \$5 billion for non-electronic waste and space programs.

Decreasing his own company and the future of the entire field at a recent meeting of the New York Society of Security Analysts, Krut noted that the field "is entering a new phase, one in which its products now concepts new technologies—while still viable in portions—will not be enough for continued success and growth."

He said electronics firms are beginning to mature, and the future belongs to those companies that have, in addition to a wealth of engineering, the manufacturing and marketing skills and management capabilities to compete against the biggest and the best.

The picture in the coming decade will be highlighted by elimination or absorption of most of the 3,500 firms in the new phase of electronic equipment, Krut said, and the emergence before 1970 of seven or eight large integrated firms producing a wide variety of components and complete systems.

The inevitable economic trend away from small companies specializing in one field already is beginning," the Raytheon president said. "In the semiconductor field, that trend has been accelerating so rapidly that soon it appears likely that network law companies will be making transactions exclusively. All subsidiaries are that the large volume of semiconductor production will move from integrated electronics companies."

Semiconductor Problems

Profit problems continue, plaguing the semiconductor field, probably will continue for the next several months, Krut said, and again be based on mid-1962.

He cited recent discussions by CBS Electronics and Raytheon Mfg. Co. to sell their semiconductor subsidiaries in a solution many firms will select. Raytheon acquired CBS Electronics' semi-

conductor plant at Lowell, Mass., but Jones and his south end it will purchase most of Raytheon Semiconductor Corp., Mountain View, Calif.

Development of solid circuits based around this film and other exotic techs appears to have extent "wards the death knell of the manufacturer making part semiconductor and selling them in someone else who puts them into a system," Krut said. "We don't feel this equipment and system designers will be satisfied with the standard types of circuits—each which there would have to be introduced—each someone else's production line."

Raytheon's move into the microelectronics field is aimed at strengthening its position in systems and secondarily aimed at producing a profitable product. "Some types of thin film technologies based around solid state devices will be manufacturing techniques adopted by the system manufacturers as time goes on, and we feel our course is to use that as a great asset at the time," he said.

Although Raytheon's volume has leveled out the last two years of approximately \$140 million, Krut explained that emphasis on creating strong joint set problems in such of its 15 divisions and "looking of the company's overall security and development program issued in 1955, to about \$15 million this year already has begun paying off.

As an example, he pointed out that 35% of total 1957 sales for one of the divisions will result from products not in production in 1959.

Rapid cost reduction and control programs throughout the company have produced substantial savings. Krut remarked, particularly in manpower, which represents 50% of the firm's total cost. He reported a manpower reduction of 2,400 during the 18 months prior to last September—on, overall clerical, administrative and indirect personnel.

Raytheon is a line and staff organization, with each division holding fairly specific product line responsibility, and the authority necessary for meeting its requirements, Krut said. The firm's staff is composed of a controlling and advisory group capable of applying special skills in divisional problems. In basic assignments, another group can provide the other.

"If the problem cannot be resolved, it comes up the line and, if necessary, reaches me when a decision is made," the Raytheon president added. The knowledge that will make the decision promptly, month months in the problem line, resolved at the first stage."

With new and better facilities, technology, and management use, an operation, Krut said, the company is confident that its rate in earnings, which progressed through the second and



Japanese Develop Anti-Tank Missile

Development of Japanese M117 anti-tank, self-propelled anti-tank missile is nearing completion by Kawasaki Group. Japanese Self-Defense Agency has ordered 930.

third quarter of 1983, in industries of accelerating profits. Overall Raytheon projects it to earn 10% of profit in 1983, and Knive and the company is aiming for a 2% profit in 1983. Sales next year are expected to top \$600,000,000.

Raytheon plans to increase its market penetration to a total government volume between \$800 and \$900 million by 1970," Knive told the analysts, adding that the figure might be conservative. "Our 40% export rate on our weapons this year is unusually high, but even at a lower, more normal rate, we believe that we can reach our goals."

The Raytheon executives said that

Harvard Professor Urges Easing Of Government Airline Regulation

Harvard, Conn.—Airline overcapacity problems and their ensuing economic consequences are typical of any specific government regulation, according to Dr. John R. Meyer, professor of economics at Harvard University.

Unlike other industries—minerals, electric, manufacturing, for example, which currently are going through the same sort of growing pains—the airlines are federally regulated, and Dr. Meyer warned against succumbing to a temptation common to a regulated industry. That is, allowing laissez-faire political expedients to avoid the financial suffering entailed in a natural reduction of excess capacity.

"Temporary alleviation," he said, "often is an attempt to perpetuate escape from economic reality. Airlines should consider the history of railroad regulation as its efforts to escape economic reality through short-term political gains."

Not all short-term measures are to be avoided, he said, in an aviation system here sponsored by the Connecticut General Life Insurance Co. Two are considered by Dr. Meyer to be the long-term objectives of the industry: open competition in the major markets.

Competitive Tools

"Airline management is not being given the tools to work in a competitive environment," he said. "There should be a substantial reduction in regulation especially in the areas of service and rates. The Civil Aeronautics Board should set out general quality-based measures and minimums—and let the carriers seek their own solutions."

Other points he noted included:

- Reduction of regulatory bias toward major. Though competition among

carriers over possible severe defense cutbacks trading much of Northeast's financial resources is understandable, since defense programs represent a dominant portion of company volume. But he noted that no substantial change in present major programs involving the Navy Space Shuttle, guided missiles and Army's Hawk air defense missile, is feasible and future programs appear solid, with gradual increase in sales.

Summing up 1983 financial status, Knive said that after about \$100 million, with fourth quarter totals higher than those of the third. No direct inventory results are planned, he added.

the few lower elements money, he said, and good performance probably could be insured by maintaining at least the current possibility of new entry into the market. In air transport, this might be done by CAB reserving the right to grant licenses for domestic operations to additional carriers.

• Characterization of status of certain markets. Two or three of the markets are operating not only in the major markets, but also in those occupied by the local service element and in what might become the markets of the third level carrier element, being prohibited.

Four Categories

Dr. Meyer broke down air transport markets into four categories:

- First level, comprising the 100 largest airports and their related city pairs which are large enough to support economic and efficient service by more than one airline.
- Second level, composed of the next 100-150 largest airports and city pairs which can support an economic service by only one carrier. This is the category known as "aircraft support units."
- Third level, the remainder of the 100-150 airports in the U.S. receiving commercial air service and which at present cannot support economic service by one carrier.
- Private market, which includes aircraft operated by corporations in competitive business.

In support of private flying, Dr. Meyer noted a controversial point—that he favored a solution to private flying to eliminate in part charges for airport and runway use between common carriers and private aircraft. Paid fees, such as those proposed to be levied on Cessnas, would only increase the discrimination, he said.

To eliminate that imbalance, Dr.

Meyer recommended dropping the 10% federal transportation tax, in exchange for changes to a comprehensive level and giving them to number of landings and takeoffs rather than size of aircraft, and developing a new part to avoid double airport costs—one part a general landing fee and the other a taxi fee.

Third Level Carrier

Development of a third level class of carrier (FAW Nos. 15 p. 44) in some smaller communities was favored by Dr. Meyer as the best solution of imbalanced service to such communities as to be envisioned.

To establish such a third level subsidy, he proposed putting it on an open bid basis. The government agency would establish a set of specifications dealing with quality and frequency of service, type of equipment and rates for different blocks of service. Then the agency would ask for bids.

Eventual aim for the second level market, once the third level carrier is created, would be to make it the direct service of individual free local service carriers operating in a natural monopoly environment with common public utility type of regulation, Dr. Meyer said.

The goal is better with competition, he said, and stressing subsidy free operation by local carriers would involve their adjustment of equipment—not often too complex and luxurious for the market of operating frequencies and number of routes in present cases where the second level markets may not be served by more than one carrier, particularly combinations of our local service carrier and one trunkline.

Difference of Opinion

Federal Aviation Agency Administrator Nilsen E. Hildebrand and his predecessor, Edward R. Gendall, viewed much over competition of the FAA during the Connecticut General Aviation symposium.

Hildebrand, one of the speakers, had said there was now to be only one FAA, not two—a reference to the two functional bodies into which Gendall had split the agency.

This remark was viewed by Gendall as somewhat of a insult in a panel he moderated at a later session. Explaining his position, Gendall replied:

"FAA is now going to a program where there will be right FAA—we can only move right as better than one-to-one a regional system where the regional offices will have the same principle and authority as the administration. This is called a decentralized management."

Gendall had also called it bureaucracy.



Rugged, compact Solar T-350 gas turbine starts any aircraft more efficiently

Here is the most efficient way to start any kind of military or commercial jet aircraft right up to the heaviest jets. It's Solar's rugged, compact T-350 gas turbine aircraft support unit.

The versatile T-350 turbine support package is available now for a wide range of aircraft support jobs. It will provide a combination of air bleed and shaft power to produce 120 kva for aircraft electrical needs, compressed air for starting, and heat and power for hydraulic, air conditioning and climate systems. The engine will also produce electrical power alone or air bleed capability alone.

In the installation shown above, the T-350 turbine is mounted on an Interceptor C-110 panel truck and supplies A/C power through two light, each capable of delivering 60 kva, or

a total of 120 kva. A remote control air bleed system allows the pilot to operate the unit if desired. The entire engine assembly rolls out of the truck for easy servicing. Standard accessories are used throughout.

The T-350 gas turbine weighs 195 lbs and measures 35 inches in length by 20 inches in width and height. The entire aircraft support engine unit weighs 220 lbs with all accessories. The T-350 engine starts instantly in any climate and operates full load without warming. It will run on gasoline, aviation gasoline, jet fuels, kerosene or diesel fuel.

Solar manufactures a full line of industrial gas turbine engines from 10 to 1100 hp. For further information about them, write Solar Dept. 1-165, San Diego 12, California.



The 195 lb Solar T-350 gas turbine engine is designed to combine high torque and low maintenance with durability and long life.



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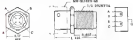
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The PC10 and PC12 Power Cartridges as manufactured by Hi-Shear Corporation, are electro-explosive devices designed as standard units to provide high pressure gas for the operation of mechanisms such as sequencers, thrust terminators and apogee systems as well as electrical disconnects and explosively actuated switches, valves or pumps.

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Dimensions 0.375 inch diameter Top/flat A; Resistance at 70°F, 0.00 ohm maximum, 1.20 ohm maximum

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Cockpit Voice Recorder

Continuous loop recorder developed by Lockheed Aircraft Service, Inc., has been ordered by Queen Empire Airways for installation on that carrier's fleet of Boeing 707s and Lockheed Electras.

The LAS Model 154 recorder, which retains a record of the most recent hour of cockpit, radio and microphone conversations, uses a 1 in. magnetic tape at 15 ips without special equipment. The unit provides four track recording with manual heads prealigned and requires no field adjustment. Plug-in module components are available for field replacement without special tools.

Available, either chromatic background noise and accurate vibration pick-up. The system includes a ground reference of proper amplitude and operates on standard aircraft power. The recorder can be installed as an integral part of the Lockheed 100 C flight recorder, attached on the outside, or can be installed separately by cabin or other means drawing a vehicle's undetectable radio net, or other self-installed unit, the manufacturer states.

Speed Devcon Division, Lockheed Aircraft Service, Inc., Corona International Airport, Ontario, Calif.

Miniature Guard Seal

New 16 in. square by 1 1/2 in. deep Mini-Dial is designed for use as a mechanical gas control for auto-transformers, testing coils, capacitors and function generators, also can be applied as an angular positioner for servitors and servos.

Mounted over an shaft extending from a panel, the Mini-Dial construction is said to pose environmental exposure. Completely gasketed, it closes under high pressure (range without lockless). Operation reportedly is quiet, and no lubrication is necessary.

Seals may be changed with turntable at 0.500 deg. at 180 deg., 0.100 in. 0.6-0.600 inch. Construction accuracy reported at 12 mil. max. of size. Coarse load ratio is 1:1, fine load ratio 100:1.

The Instrument Corp., 520 Victor St., Solihull, Brook, N. J.

Cryogenic Quality Meter

Automatic instrument continuously measures fluid quality in two-phase cryogenic flow systems.

Operation is based on the determination of dielectric constants of the liquid and of the vapor in two-phase fluids such as liquid hydrogen, liquid nitrogen and liquid oxygen. The instrument provides a continuous indication of percent vapor, by volume, over 0-100% with an accuracy of 1% full scale and within 1 dia to 400 psi.



Readout appears on a control panel which includes provisions for deriving a step chart recorder, high speed oscillograph or oscilloscope. The instrument consists of two main assemblies: the probe, test section and an electronics unit.

Allied Research Associates, Inc., Industrial Products Dept., 45 Lem St., Boston 15, Mass.



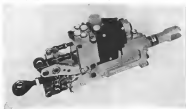
Beta-Gamma Monitor

Self-contained beta-gamma radiation monitor, designated Model EP-511 VAMP, is designed for use in any area where radioactive materials are stored or handled. The instrument, intended for 24-hr operation, can be preset to sound a loud siren tone and/or flash a light whenever radiation exceeds any specified level. An on-line display warning light indicates extent or detection of radiation.

The portable monitor is enclosed in a dusttight metal housing for wall mounting or free-standing use. It is available with a built-in detector or an external detector connected to the housing by a flexible coil cable.

The instrument has a completely tamperproof control which is naturally adjustable to sound the alarm at any point from 20,000 dpm scale with an accuracy of 10% of the indicated reading.

Victor Instruments Co., 5665 Hough Ave., Cleveland 3, Ohio



Hydraulic Power Control Units

Three hydraulic power control units, developed for Hush-Sidley by the Hydraulic Division of Faxon Engineering Ltd., provide power for release and lockout of the Hush P-117 VGR, while lighter, new underwing traction tests to Great Britain. Units are tied to automatic stabilizing computer system, with very tendency toward pitch over as roll caused by gust pressures and augmented through electro-hydraulic control system to the hydraulic pilot. Bank test also can accept the most direct inputs from the pilot, a number of P-117 traction have been used with manual control.

• PERFORMANCE CHARACTERISTICS

Firing Reliability

Alt Fire - 25,000 shots in 70°F
PC10: All fire reliability 99.9 at 95% confidence level. Current applied to trigger element only.
No Fire - 10 shots in 70°F with 1 minute at 70°F.
PC12: No fire reliability 99.9 at 95% confidence level. Current applied to both electrodes simultaneously.

Recommended Firing Circuit

4.3 amp (max) at 70°F
2.8 amp (max) at 300°F
1.5 amp (max) at 500°F
PC10: 8.0V reliability at 95% confidence level
Current applied to both electrodes simultaneously.

Electrostatic Sensitivity

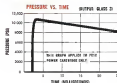
No action when 500 stat coulomb at 10,000 volts is discharged between charged contact pins and copper flange at 70°F, and at ambient pressure.

Dielectric Strength

3 megohm minimum resistance at 100 VDC for 5 sec. between any 2 conductors.
2 megohm minimum resistance at 100 VAC for 1 min. at 70°F and at ambient pressure.

Pressure Released

50,000 psi peak pressure in 8-10 mil. sec. burst duration - PC 10 only.





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■ lock nut, ■ lock washer and plug retaining unit.



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AVIONICS

All-Weather Capability Studied for 707

Seattle—Details on a joint Boeing-Bendix program to improve the all-weather capability of the 707/720 jet transports were disclosed here, to representatives of 17 airlines now operating the aircraft, and to the Air Force, at a three-day symposium.

The symposium, sponsored by Boeing Co.'s Transport Division, described the company's three-phase program whose ultimate goal is to provide the capability for transport aircraft to operate in zero-zero weather. Most immediate objectives are intended to achieve 200 ft., 5 min minimums followed by lower minimums, or perhaps 100 to 125 ft. and 25 min. CAW. Now, it is p. 131.

Being aware of the weather problem presented at the composition flow rates why there is considerable concern airline industry in reducing jet transport emissions. In the U.S., for example, there is an average of 144 lbs per year when jet emissions of 300 ft. 75 percent, compared with only 70 lb for propeller aircraft emissions of 300 ft. 5 mi. This means that diversion or cancellation occurs twice as often with jets as with the older aircraft.

Figure 1 for weather insurance on a global basis shows an even higher percentage of adverse weather conditions which explains in part the large interest of international carriers in improving all transport adverse-weather capability.

Present Address:

With a constant per minute of 300 ft and 75 m, significant gains in net revenue can be obtained from a modest investment in upgrading the engine and autopilot performance. Recent studies indicate: The crossover point, where the cost of additional computer, upgrade hardware and software is equal to the net revenue gain, occurs quite commonly at a time somewhere below 200 ft and 5 m, although the precise numbers cannot be firmly fixed at this time. Beyond this point, the cost of pushing performance down to the status of zero two hundred feet or 5 m usually does not keep pace with the revenue that is lost. See also p. 93.5.

One issue in the Boeing symposium was to appraise airlines of the fact and to clarify Boeing's aim in the program, which is to study the problems, monitor the systems developed in the U.S. and abroad and to continue, to improve present equipment. Boeing emphasized to Aviation Week that it does not want to get into the position of developing a costly system which would be

formed upon the advice by competent or regulation. The assessment in the current was one reason for conducting the comparison.

At the same symposium, Eclipse Power Division of the Reader Corp. outlined a program which it will follow to improve performance and reliability of its substation systems in the 705/738 Area of the substation improvement program is similar to that of the substation program in that efforts to achieve maximum will be directed toward the final goal of providing a blind loadable system. (For Reader program details see p. 34. Last column is an p. 99.)

Scientific Milestones

Most participants at the responses agreed that minimums of 200 ft and 5 mi are realistic with the present equipment providing the reliability and performance of the equipment is brought up to a higher standard.

As Lane Public Assn., however, indicated in a recent safety forum that approaches below the present minimums of 300 ft and 75 mi would be unsafe in jet aircraft without dual approach navigators, dual antennas and dual flight directors (AW No. 6, p. 103). This raises the prospect of another runway accident disaster when the surface runway Federal Aviation Agency approval for low-altitude instrument Aids is

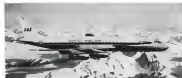
speakers have taken a strong stand against any new procedures which might lower standards for economic or political reasons.

Agency of Indonesia

These separate areas of interest were discussed at the symposium, all related to the safe lowering of emissions and related attainment of blood lead.

- **Antipod approaches**—also known as the "Antipod" approach—was developed by the Ecology-Physiology Division of the Bend Sin Corp. It is an attempt to improve antipod reliability and closely monitor the health of the pod during the service approach, although it does not require a pod to be in a "pod" position. It does approach to 100 ft and 5 m can be made without antipod approaches in lower class pods. The pod is in a "pod" position and will subduct, rotate, and rotate flight.
- **Controlled approach**—also known as the "Controlled" approach—is the most commonly used in the low speed regime. These changes will be made into the production line, which are possible in the field with a structure in the field. The pod is in a "pod" position and will subduct, rotate, and rotate flight. The stream subducts and can be discolored.





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PHOTO-DIELECTRIC TAPE CAMERA SYSTEM

... a major advance in space image-sensing



The development of photo-dielectric tape permits the design of a totally new image-sensing system for observation in satellites and space vehicles. A photo-dielectric camera for use with this tape has already been developed and tested. This system, one of the first developed primarily for use in space, offers a number of advantages over existing photographic and television techniques.

Operating on the principle of storing an optical image by converting it to an electronic charge pattern, the photo-dielectric system has inherent high resolution since the picture charge pattern is read out directly as a video signal by an electron beam. Moreover, it offers real promise of providing responses in various parts of the radiation spectrum in addition to the visible including infrared and ultraviolet with sensitivity better than standard photographic techniques.

Readout is accomplished by use of a finely focused electron beam which scans the charge pattern. It is then converted directly to a video signal for transmission to the ground. Readout can be accomplished at different speeds to compensate for various power and band-width requirements dictated by the nature of the space mission.

The flexibility of the system permits readout of the same image numerous times, if desired, by ground control. In the laboratory, the same image has been read out up to 180 times without sensor degradation of quality. Yet, the image is stored completely, with no loss of "history," in the tape in flooded with electrons prior to exposure. Transmission of the package results in minimum weight and low power requirements.

Since a high vacuum is essential to the operation of a photo-dielectric tape camera system, it is "at home" in the harsh environment of space. Also, the photo-dielectric tape is virtually unaffected by radiation thereby eliminating the hazard to ordinary photographic film. It is also reusable and serves as its own storage medium for camera picture-taking sequences.

To find out how RCA's new photo-dielectric tape camera developments can fit your requirements for space image-sensing systems, write to: Manager, Marketing, Audio-Electronics Division, Defense Electronic Products, Radio Corporation of America, Princeton, New Jersey.

And for a challenging, rewarding career in electro-optical systems development, apply to the Employment Manager, RCA Space Center, Princeton, New Jersey. All qualified candidates are considered regardless of race, creed, color or national origin.



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directional features with considerable improved accuracy. Progress is being closely followed so that such improvements can be integrated with the advance weather landing capability.

An inherent part of making an aircraft safe for operation in adverse weather is decreasing the possibility of emergencies occurring close to the ground. Boeing has investigated several means of improving controllability by adding control systems.

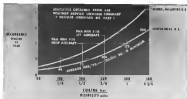
Pitch control changes involve replacing the pilot's three-dimensional trim switch with one less likely to stick. Also included is the addition of a trim wheel to the hub of the control wheel to facilitate changing faulty switches.

Revisions also are planned to the elevator trim least because it has been determined that in some models 1 deg. every time up trim was available and 1.5 deg. every time down trim was available. An adjustable trim limit switch will eliminate the possibility that a runaway trim will produce more trim than necessary, adding a switch later in the event of such an emergency. Manual trim will still be available to the present stage.

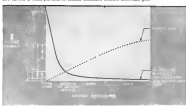
Elevator trim itself is under test to determine the feasibility of installing a device to stop runaway trim without requiring other pilot to remove a hand from the control yoke. On a test bench the device works to prevent current to the trim system if the control valve is displaced in a direction opposite to the direction of trim. For example, if the trim system is lowering the aircraft nose up and the pilot combats this with as much as two degrees of forward elevator movement, the trim will cut out. The reverse is true for nose down trim and is designed to eliminate runaway trim with a natural counter-tendency to the trim. Trim is now direction controlled by control movement in the opposite to the situation which would exist in a runaway trim emergency. Tests are being conducted now in determining how much control movement should be required to cut off the trim.

Revisions also are being made to the spoiler trim system which will permit symmetric spoiler deployment in the event of failure. Instead of individual dualist valves for both spoilers in both wings, there will be one dualist valve for each set of spoilers, combined and identical. Modifications also are being made to the aileron trim spring cartridge to permit better balance of that trim.

Directional control improvements also cover the yaw coordination aspect of eliminating excessive yaw rates of the yaw damper system. A new rudder power vent is being considered which will isolate a full time yaw damper. Then, yaw damper inputs will be superimposed on the rudder but will not be fed back



BOEING STUDY shows impact of higher maximums for pressure on active operations in U.S. and on worldwide basis. For example, pressure maximum of 180 lb. and 1 mile means more than twice as often in U.S. as previously allowed maximum of 100 lb. and 1 mile, and situation a worse on global basis. Significant maximum gains can be achieved with modest cost improvement of airplane and anticipated to possibly lower yet maximum, but somewhere below 200 lb. and 1 mile, the cost of further alterations exceeds economic gain.



to the pilot's pedals. Since the new order has been made based on test for all aspects the need for hydraulic pressure reduction at high speed is eliminated. Also, the dynamic pressure spring is no longer removed and several other components can be recovered or combined resulting in a weight saving of about 40 lb.

Directional Control

Directional control on itself may be made easier with an interconnected modified steering unit coupled to the rudder pedals. This feature, which enables the pilot to keep at least one hand on the control yoke at all times, has been considerably favor with the aid of the DDCS (Directional Control System) authority through the rudder pedals will be limited to 10 deg. and probably will be made proportional to situation of the rudder pedal itself.

The usual effect of adverse weather on normal conditions in the form of rain, ice or snow is being considered in development of a solid-state air-aid

system, which preliminary tests show will increase deceleration rate by as much as 51%. Rather than an "on-off" system such as at present, the modified system will be a fluid pressure line which is put below the third point and will apply more or less constant pressure.

Finally, the new revised system is being improved to be more effective during landing. The greatest need for the system is on landing but since the new revised system depends on engine compressor bleed air, it becomes less effective when the engines are reduced to idle just before runway contact. Several means are under consideration for increasing the amount of ram air available or to effect ram air removal and improve visibility by other means.

Robert Aviation Agency and Boeing are conducting a research program probing several areas of interest in lowering landing minimums. The Boeing 707 prototype, the 747-80, will be used in evaluating new instruments and warn-

ing is most significant control—auto pilot—will be evaluated. The pitch, roll, yaw, and altitude control will be evaluated. The pitch and roll control will be evaluated. The yaw and altitude control will be evaluated. The pitch and roll control will be evaluated. The yaw and altitude control will be evaluated.

Determination of the maximum allowable error in the 200 ft approach will be made to establish go-around criteria. The initial analysis will be made in a flight simulator with uniform being provided by flight test. Both lateral error and vertical error will be considered along with the possibility of completing the approach under various atmospheric conditions.

Instrument warning systems to provide warnings and positive indication of instrument failures in the pilot will be evaluated in the 707 prototype under all weather flying program. Scheduled also for flight test are new versions of:

- Pave Visual Director (PVD), devel-

oped by Smith Instruments of England, are installed along the lower edge of the windshield in the cockpit's position to display roll, pitch and yaw information also shown on the conventional flight director instruments. These indicators resemble striped barber poles with the pole axis aligned parallel to the aircraft axis whose information is displayed. When flight director is calling for a right turn, for example, the roll-yaw PVD displays indicator rotates in that direction. Having will evaluate the effectiveness of the PVD display in easing the transition from instrument to visual flight on low approach.

• Terrain clearance and rate-of-descent indicator, a symbol, non-numeric type instrument developed by Lear, will be tested to evaluate an experimental type. The system uses the output of a radio altimeter for terrain clearance and by keeping the rate-of-descent indicator superimposed on the terrain distance reduction, the aircraft will follow an exponential descent. The rate can be adjusted to provide a terrain

two in the display at which descent is commenced.

• Speed command, shown from angle of attack and displayed on the flight director pitch bar will be tested for usefulness in monitoring proper speed on descent and landing. Better performance in takeoff plus the utilization of lower approach speeds are chosen as some of the advantages of the speed control system.

• Approach thrust constant computer combines the information supplied by the speed command system with observed engine thrust. Tests will be flown in which both speed command and thrust command will be displayed on the flight director. Not effect is to again achieve lower approach speeds which will result in shorter landing distances.

Eclipse Pioneer and Boeing also are conducting the FAA research program on improved directional heading system now being installed at Atlantic City N. I. and the improvements in runway lighting procedure under consideration.

Bendix Improves Autopilot Performance

By Philip J. Kline

Eclipse Pioneer Division of Bendix has launched a three-phase program to increase the performance, reliability and pilot confidence in its PB-20 autopilot and approach computer at a major contribution to the flight program to improve the adverse-weather capability of its 707-720A series.

Bendix program is being carried out in three steps:

• **Phase I** autopilot modifications are being made to improve performance, particularly during coupled approaches. These will appear in new PB-20 autopilots coming off Eclipse Pioneer production line starting January.

• **Phase II** depicts changes intended to improve approach computer reliability and maintainability. These are scheduled for flight test in July and will introduce into new autopilots delivery after January, 1967.

• **Phase III** a long-range program to investigate, and implement when desirable, such new features as control stick steering, roll-yaw operation, automatic descent and rate automatic speed control.

Aviation reporting 707-720A will be able to update these existing PB-20 autopilots in atmospheric Phase I and Phase II changes and later Phase III additions. This can be accomplished either by purchasing a new PB-20 au-

topilot-computer cluster containing a speed control system, or by coupling existing program modules can be transferred, as the current changes can be accomplished in existing clusters by an in-place upgrade.

At the time of the January, 1967, factory changeover, Eclipse Pioneer will introduce a new series of program units.

Functionally, these units will be able to perform modules in instrument interchangeably. But they will in composite, the latest pieces of logic and logic components such as new terrain and rate-of-descent indicator, and new altitude display, chief components of the flight con-

trol laboratory. In some instances the new modules will be smaller and lighter.

The company refers to the PB-20 improvement program as TALL, an acronym for "Total Autopilot Long Look."

Number of the improvements in the TALL program are the result of intensive program launched within the past two years by several major airlines to track down shortcomings of all present autopilots and flight directors to improve the adverse-weather capabilities of their aircraft, particularly the jetliners.

Early in 1965, Pan American World Airways, first of the U.S. airlines to launch its adverse-weather program, set out to do its autopilot and flight director equipment and to facilitate its flight crew with their operations (AW Jan 15, p. 10).

In January of the year, PanAm began to encourage its line pilots to use autopilots, approach computers and flight directors whenever possible, and to make a written report on their performance after each such flight.

Tracking procedures were altered to require crews to make an under the hood approach to 100 ft in jetliners using flight director during precision flight, and a new approach requirement will be added for coupled approaches when additional improvements are made in the approach computer.

Pilot reports are analyzed by an action team from Bendix and Sperry to select SP-16 autopilot is used in Bendix's DC-10, as well as in the Boeing 747 program and maintenance personnel to pinpoint areas that need improvement and change.

At recent Radio Technical Conference on Avionics meeting in Washington, D.C., by McDonnell, who spearheads the Bendix program, and the Bendix DC-10 program, "outstanding" and used to report that pilot reports will reflect the improvements. McDonnell and Bendix has formed a group to work with Sperry on a similar performance improvement program for its SP-20.

How any some of the performance improvements which will be introduced into new PB-20s starting in January, and which will be incorporated into existing equipment.

• **Full-rate command modifier** in the PB-20 design, pilot must now accept course selection switch to "manual mode" before putting aircraft on a new magnetic heading or a different VOR radial. Boeing is to do so before turning the heading knob on the course deviation indicator can introduce a sharp roll maneuver. The new circuit eliminates the need for pilot to maneuver to return to natural mode and health the environment will rate under such constant conditions to four degrees per second. The modification also enables the autopilot better control to



Satellite Track Display

Satellite track display which shows orbits of up to six satellites superposed on a monitor projection of the earth, now also shows instantaneous position of satellite by brightest light when operator points light gun at earth. Display, developed by Fairchild Electronics Co., Irvine, a subsidiary of and an Air Force Research & Development, L. G. Fairchild, Irvine.

radar vectoring used in high-density terminal areas in permitting expansion of the localizer beam capture, while while while in a bank. This character is extra pilot maneuver and reduces beam capture time.

• **Weather VOR status passage** When aircraft is coupled in a VOR status beam, the gradient angle becomes zero, but as the gradient approaches and passes over the station-on area known as the "zone of confusion," in original PB-20 design, when the airplane enters the zone of confusion, the autopilot coupled incorrectly and the aircraft flew on a constant magnetic heading until it passed the station. In the new configuration, the VOR signal is a series of pulses that is a variable rate (by an integrator) to obtain a less error signal. This is expected to provide weather passage over the zone of confusion and eliminate problems of coupling the VOR signal when airplane is in a steep climb.

Performance is expected to be independent of airplane attitude, air speed and station cone width, according to Edward Zelnick, PB-20 project engineer for the TALL.

• **Crosswind compensation.** New circuit and change in calibration of the lateral axis integrator is expected to reduce by half the track length error per autopilot in compensation for crosswind when flying a VOR or localizer beam.

Modifications planned for Phase II of the TALL program are intended largely to improve reliability and ease maintainability of the approach computer system.

tion of the approach computer, but will not be limited to this function.

For example, a cross-tolerance integrator for pitch axis will be introduced to eliminate small oscillations while proceeding down the glide slope. Another change is intended to advance tighter constant-velocity control under high wind conditions. Many of the changes are intended to make approach computer performance more independent of variations in altitudes of aircraft closures, including variations due to speed of climb.

Other changes will take place in construction and laboratory techniques. For example, Bendix will change from soldered connections to connector pins with crimped connections. The latter (crimped) pins, compared to solder, are more reliable and can be replaced on an aircraft with a double row bearing. This is expected to eliminate the need for periodic removal of the pins, cutting assembly time and cost and reducing pin drift.

Eclipse Pioneer is investigating, and in some cases already flight testing, a number of possible new additions to the PB-20 under Phase III of its TALL program. These include:

• **Variable beam capture angle.** When PB-20s approach coupled angularly via magnetic, it was designed to require the pilot to intercept a VOR in localizer beam at an angle of approximately 95 deg—the standard instrument approach procedure of several years ago. With changes in jet, the increase in traffic density in terminal areas and the use



IMPROVED PB-20 autopilot, designed to permit operation of 707/720A in lower minimums, is achieved by incorporating program modules into existing equipment to a new autopilot-computer cluster containing new circuit changes. Improved program modules for PB-20 will be available to airlines on an optional basis. These will use high reliability components and in some cases, such as quadrate sense shows at right, a single unit will perform some functions in two or three older modules.

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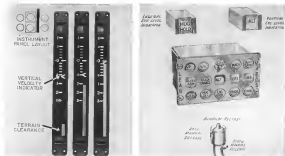
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VERTICAL INDICATOR for displaying aircraft's vertical velocity and absolute altitude is one of the instruments which will be evaluated by Lear in terms of improving pilot's ability to monitor an adverse weather landing. Making tops show absolute distances above ground while moving, top shows vertical velocity. A pilot Lear Air France program also will evaluate two small indicators (right), mounted in speeded area modified, to show pilot precise operating mode of each rate of altitude previously set into controller (below).

Caravelle to Test Autopilot Modifications

Washington-New techniques in autopilot design will undergo flight test soon aboard a Caravelle as part of a joint Lear-Sud Aviation program to lower operating expenses and overall traffic adverse automatic landing.

Program is sponsored by the U. S. Federal Aviation Agency and the French Air Ministry. Details of the program were reported by Lear's Kenneth Kramer at the recent meeting of the Radio Technical Commission for Aeronautics (AW Nov. 5, p. 11).

First phase of the three-phase Lear-Sud program involves modification of an existing L-182 autopilot and computer to enable the Caravelle to auto couple approaches down to an altitude of approximately 100 ft.

Tighter Coupling

To achieve the tighter coupling of aircraft to localizer required for lower minimums, airplane will be "side slipped" rather than moved whenever it deviates from localizer beam center. This new strategy, expected to accelerate aircraft return to beam center as first proposed by Stephen Krumm of the Automation Systems Division's Flight Control Laboratory in Dayton, Krumm said.

To achieve the new type control, the rudder use of the autopilot will obtain its signal from the flight director into which the pilot has preset course heading. The roll use of the autopilot will be coupled to the localizer receiver, as at present. When the airplane deviates from the localizer, the autopilot will bank the airplane but the rudder will duplicate to keep airplane from turning, causing it to sidestep back to ward the beam, Krumm said.

In addition to providing new precise localizer coupling, the technique requires airplane heading aligned with the runway, maintaining the de-rotary counter-verse prior to touchdown in the presence of a crosswind.

One possible objection to the adaptive method of control is passenger discomfort. However, Krumm said that if bank angle is limited to between three and five degrees the amount of side slip is not objectionable. This conclusion is based on flight tests conducted by Lear in a B-36. The Flight Control Laboratory, also has tested the new technique in a C-119 (Krumm) with excellent results. Krumm told Aviation Week.

Lear also had modified the L-101 to improve runway coupling to the glide slope. Ideally, the gain of the autopilot should be decreased as the airplane approaches the runway because of the converging glide slope beam. Is

present autopilot coupler design, the pitch rate coupler gain usually is set at a single medium value. This makes the coupling too loose in the far end of the glide slope and unstable near the runway.

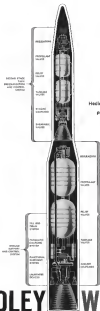
Lear has developed a simple automatic continuous gain changer which uses only a barometric pressure and an altimeter reading computer. The pilot sets in the barometric pressure of the airport and its runway altitude. The device then automatically decreases coupler pitch rate gain as the aircraft descends the glide slope.

Another pitch rate modification will provide very high gain during initial glide slope capture mode, to assure steady beam capture, after which gain returns to normal value.

Automatic Flare Computer

Second phase of the Lear-Sud program, aimed at automatic landing, is already under way. The objective is to provide an automatic flare-out computer which will enable aircraft to consistently touch down within 75 ft of the average touchdown point, Krumm said.

Lear's philosophy is that the computer used for automatic flareout should, if possible, be the same one used for glide slope control to give



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assure that it is working properly before anyone reaches lift-out at night, Kerner said.

The question of whether a simple exponential (open-loop) type linear computer will prove adequate or whether the more complex reconverging (internal feedback) type is required is one which lends itself to answer in current tests in its B-26 and later tests aboard the Seal Aviation Composite. The reconverging type provides more precise control of bandwidth, a point

The heart of a simplified engineering-type computer, now being in the B-2 is an instantaneous vertical velocity sensor developed by Lear. This uses a laser-type rate-of-descent sensor to obtain a steady-state reference signal and a vertical accelerometer whose output is integrated to provide an instantaneous vertical velocity signal.

By summing these two signals, a signal proportional to altitude rate of change is obtained which is completely independent of lag in the barometric sensor and the radar altimeter. Kruysen et al.

Rate-of-Descent Signal

This rate-of-descent signal is used to control the pitch axis of the autopilot both during glide slope approach and during flare out. At the instant of initial engagement with the glide slope beam, a rate-of-descent signal representative of that found on typical glide slope approach is introduced into the pitch axis. If aircraft does not stay centered on the glide slope beam, the rate-of-descent compensated by the auto-

plot is automatically changed until the aircraft does remain constant on the glide slope.

In this way the glide slope beam signal serves as a structure rather than the primary source of control for the air plane's pitch axis. This decouples the aircraft from undesirable bends in the glide slope beam.

Command Changed

When altitude reaches an altitude of 200 to 300 ft., as determined by the radar altimeter, the glide slope becomes a gradual, arcuate or wavy line by the time airplane has reached 100 to 200 ft., the aircraft is continuing to descend at the average rate of descent of the glide slope prior to its arrival. When aircraft reaches an altitude of about 10 ft., the rate-of-descent command is changed approximately to provide an exponential or modified exponential flare to touchdown.

The technique provides effective monitoring of the glide slope beam, particularly at lower altitudes and keeps the radar altimeter out of the direct pitch rate control loop, using it only to determine whether to start fading out the glide slope monitoring and when to initiate the flare.

Eventually, Law plans to replace the simplified line computer with one that employs recomputation for more pre-

ose control of touchdown, but will retain the out-of-domain control. Kueyer indicated.

A third phase of the Low-Sun program calls for evaluation of different flight techniques and mission displays to enhance the ability of the human pilot to monitor adverse weather coupled approaches and automatic landings. The British Surface Instruments Co. Personnel directors similar to those under evaluation by Boeing, are expected to be tested.

Also, Lear will evaluate use of moving-type type vertical indicators which was developed by the company under Air Force sponsorship, and is also being tested by Boeing.

System Monitor

Current thinking at least is that if it proves necessary to have an automatic autopilot performance monitor the best approach is to use two identical autopilots, each with its own auto actuator, operating in parallel. If one of the two autopilots malfunctions, the other will act to compensate for its wanted control action. Additionally, failure of one of the two systems should

PROBLEMATICAL RECREATIONS 94



Two hot rockets compete in a drag race. Each accelerates at a uniform rate from a standing start. Al covers the last 1/5 of the distance in 3 seconds; Bob covers the last 1/5 in 4 seconds. Who won, and by how much?

—Contributed

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assure that at least one will be open (used) for use in a coupled approach if the need should arise. The dual autopilot approach requires only the added weight of the servo actuators compared with the single autopilot with automatic reversion approach. Kriener believes this is a small price to pay for the added features.

Leet has flown this dual-opening autopilot system concept in a high-power, low-altitude jet aircraft with very satisfactory results," Kriener said, and continues to have fabricating prototype hardware for flight tests on another high-performance jet.

In addition to the program with Sud Aviation, Leet also has a project under way with Air France. Its objective is to permit an immediate lowering of present weather minimums on the Concorde, equipped with the Lear L-102 to 100 ft and one-half mile. The program aims to achieve this objective with minimum modification of the existing equipment.

Company-owned Learjets, based in Geneva, is being used to test autopilot improvements. Those features which Air France finds desirable will be fabricated and flight tested then on a Concorde.

In addition to changes intended to improve glide slope capture and provide another capture and tighter tracking of the VOR and localizer beams, Leet is evaluating the following new safety features:

- **Engine-level selection,** mounted directly under cockpit windshield to show pilot whether autopilot is engaged and in which mode it is operating.

- **Control wheel detenting,** a simplified type, using switches permits pilot to disconnect either or both autopilots even for manual execution of the engine-wide autopilot crosshatch—maneuvering to the new engine heading/altitude and in ready for manual take-over when wheel switch is released.

- **Maximum altitude hold,** which will prevent aircraft from inadvertently descending below 100 ft altitude while making a coupled approach. Using speed bars as entering radar altimeter, the autopilot automatically will level out and hold approximately 100 ft altitude if pilot is engaged in making visual contact and fingers to disengage the autopilot.

- **Automatic throttle control,** a simplified system for controlling throttle position to maintain constant airspeed has been flight tested on the Learjet and a prototype system is scheduled for Concorde tests early next year.

Second phase of the program for Air France calls for incorporating the auto-rotate landing computer currently being developed as part of the Learjet-Sud Aviation program.

For the aviation industry another new from Binks

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MODEL OF PA-29 shows wide track main gear which was adapted to simplify landing and ground handling for students and business pilots. Disposed will not stall.



BUBBLE-TYPE CANOPY provides ample headroom, good visibility and eliminates structural cross needed for door. This tail, below, is similar to Cherokee and Cherokee.



Plastic PA-29 Project May Benefit Entire Piper Line

By Erwin J. Boffen

Vero Beach, Fla.—All plastic Piper PA-29 Papoose "concept" biplane, due to start flight tests here early in 1967, represents a full-scale research program aimed at material, engineering and production breakthrough that may markedly increase the company's entire line of business and utility aircraft in future years.

(Piper is considering dropping the name "Papoose" for the PA-29 project. The name, which has been with the project almost since its inception, is considered undignified by some company officials.)

Primary goal of the Papoose project now is to thoroughly research an all-plastic structure for this class of airplane as an attempt to achieve the twice price reduction in price. Management feels this reduction is necessary if Piper is to achieve its aim of bringing flying to a truly mass audience (AW Nov. 20, p. 14).

The project has concentrated the company to a single experimental study, development work started some three-and-a-half years ago and now encompasses a considerable portion of Piper's resources here. Piper management maintains that it is not purely research and, because of the initial approach it represents, they want to see for themselves how the airplane performs under actual operating conditions before any commitment is made for production. The Papoose project represents a major breakthrough from Piper's past research and development programming. Formerly, research toward development experiments in previous designs, Piper is now placing major emphasis on research in this particular program because of its direct divergence from conventional materials, processes and engineering requirements.

The basic Papoose experimental configuration currently measures 25 ft in wingspan, a 20 ft 5 in. long and has a wing root height of 7 ft. Wing area totals 110 sq ft. In comparison, the Colt has a span of 30 ft, a length of 23 ft and a height of 6.25 ft and the wing area totals 157 sq ft.



TRAILING EDGE of center wing section shows curves possible with plastic molding.

Engineering and plastic production techniques are somewhat more optimistic because of the success they say has been achieved thus far in developing the structure and processing techniques, although they admit the final measure of the product will be in the flying. They expressed little doubt that the program could be applied just as well to the company's entire line of aircraft. One high-ranking member of the staff here told Aviation Week he saw no reason why it couldn't be applied as effectively to aircraft of the size of a DC-3. Indications are that component testing thus far has resulted in studies being made on how molded plastic could be applied to current aircraft in the future. One outcome mentioned was consideration of fitting foam-type container main gear struts to the Piper aircraft Cherokee.

How quickly this feedback is incorporated in the other airplanes in the line probably will be determined after the Papoose completes its extensive flight test program, and also by how soon large investments in conventional tooling can be justified.

The entire program is geared to developing an airplane that can be marketed at a substantially lower price than the current steel tube and fabric two-place Colt, which as the standard version lists for \$4,995. How much less the Papoose will cost is something management declines to discuss, beyond saying that if the all-plastic Papoose can't do a better job at less cost than the Colt they wouldn't bother with it.

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LEADING EDGE of center wing section shows how it is molded to fit flush with airplane's bolts. "Repeater" in wing is not just, but will take up these bolts. Landing gear, at right, is all plastic. Box in wing will absorb landing shocks.



MAJOR PLASTIC ASSEMBLIES will slowly assemble the dismantled model. Wing will have cone, control and instruments installed before it is mated to fuselage.

The Papoose is designed around the Colt's basic concept, a 105-hp Lycoming O-375-G1B. But the Papoose is expected, after development, to be lighter than the Colt's 1,550 lb. actual gross weight. Because of this and its considerably aerodynamically cleaner design, it is expected to show significant gains in performance. What the final Papoose configuration will weigh is hard to determine now, Aviation Week was told, because the prototype airplane will represent a loaded up structure that will be added as the test program goes on.

The early structure is of honeycomb sandwich material. Layers of 4 in. glass fiber cloth form the top and bottom skins covering approximately

2-in. thick Kevlar 18-mil paper honeycomb. Honeycomb-patterned paper is supplied by Douglas Aircraft Co. in sheets 15-in. wide and 16-1/2 ft. long.

Fabrication Process

Components are fabricated in high-temperature open plastic molds designed and built by Piper's Plastic Division here. The company is reluctant to discuss exact details of the process, since they say, that this is the key to maintaining low-cost output. But it is known that actual techniques forged the sheet separately in individual molds, then transferred them to another mold where they were plasticized in the honeycomb paper. However, the process was abandoned be-



LEADING EDGE of center wing section shows how it is molded to fit flush with airplane's bolts. "Repeater" in wing is not just, but will take up these bolts. Landing gear, at right, is all plastic. Box in wing will absorb landing shocks.

"I don't know who you are.
I don't know your company.
I don't know your company's product.
I don't know what your company stands for.
I don't know your company's customers.
I don't know your company's record.
I don't know your company's reputation.
Now—what was it you wanted to sell me?"



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case, it won two time-consuming and costly and the current system developed here is a "one-shot" process.

It involves placing a plastic-cupping mold plate on the mold, positioning the honeycomb paper and then completing the sandwich with the top layer of cloth. This is then covered with vacuum bags to maintain the pressure necessary to hold the three together during the last curing process, which involves temperatures of 200F for two hours.

The exact technique of sandwiching the glass fiber cloth skins is also a subject which is discussed little with outsiders. This technique required considerable development to prevent the plastic faces charring out of the cloth while the cloth is lying on the honeycomb and padding is in the sandwich.

Production engineering is slanted toward an optimum plastic structure made of a minimum number of components. As a result, the faulage is held in two halves, split vertically with its integral to the structure. The wing also is made in two halves, comprising top and bottom sections. The wing contains no ribs, stringer or spar—the only additional structures are the spar web "spine", designed to keep the sections apart and release shock loads and plastic-honeycomb faces which take up loads from the carbon fiber plastic honeycomb when testing gear starts.

Wingtips also are separate plastic structures, and are made detachable to permit inspection of the wing airfoil. To give more evidence of reduction in components plastic with plastic construction, the Papoose wing comprises a total of 35 parts, including all hardware. Plastic Division Manager Robert Drake told Aviation Week, and the entire section assembly will probably comprise just over 100 parts.

Actual assembly, since the wing, fuselage and other components have been completed, will further be simplified since cockpit components, such as seats, instrument panel and controls, will be installed on the completed wing prior to mating it to the fuselage.

Maintenance cost of the airplane is expected to be extremely low. Engineers believe it will be possible to incorporate coloring in the polycarbonate plastic so that "paint" schemes will be integral with the structure, although exterior painting will also be possible.

Structure is certainly corrosion-proof due to its plastic makeup and also waterproof, since even the paper honeycomb is water resistant.

Repetitive to the structure will require a minimum of daily, they add.

They feel that the plastic structure is superior in fatigue life to a similar conventional metal structure. Tests on a full scale experimental Papoose wing

Piper Sales Forecast

When Piper Stock, Inc.—Kittling sales volume of approximately \$10 million is expected by Piper Aircraft Corp. for 1962 according to J. W. Miller, sales manager.

This is within the sales target set by the company for 1961, which actually resulted in sales of some \$10 million due to a sharp decrease in business resulting from the U.S. business recession only last year.

Miller is optimistic that Piper will come closer to next year's target largely because field operations are at a more stable level. He told Aviation Week that company distributors and dealers had secured field aviation of one and two-passenger aircraft for about \$4 million in the past 15 months.

have included plans leading that reduced 210% of design loadings—can actually above Federal Aviation Agency's normal requirement of 165%—and balance was only experienced because a not future failed and passed the wing. Drake pointed out that in cold temperature tests, the material has shown improvement in all physical characteristics during tests which subjected it to -12F.

PHYSICISTS

Maximizing nuclear power for propulsion of large space vehicles is one of the many advanced programs now underway at the John Jay Hopkins Laboratory of the General Atomic Division of General Dynamics in San Diego, California. This and other advanced programs have created career opportunities in the following areas:

■ **EXPERIMENTAL PHYSICISTS**—for solid state and semiconductor studies, acoustics, high vacuum systems, plasma devices, shock tube and high energy particle physics, photochemical research, radiation effects, nuclear physics, high altitude studies.

■ **THEORETICAL PHYSICISTS**—for solid state and atomic physics, plasma theory, and hydrodynamics.

■ **REACTOR PHYSICISTS**—for reactor analysis and design, hazards analysis, and thermionic reactions.

The John Jay Hopkins Laboratory is the largest and most diversified privately owned nuclear laboratory in the world. In addition to nuclear space vehicle propulsion, other programs include: high temperature gas-cooled reactors for electric power and ship propulsion... systems for direct conversion of heat to electricity... controlled thermonuclear reactions... TRIGA research reactors... and basic research in the sciences.

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GENERAL DYNAMICS | GENERAL ATOMIC DIVISION

Strategic vs. Tactical

I had to see your "Dread Phoenix" (AW Nov. 6, p. 27), but I think I recognize another equally convincing argument for that. The Communists, attacked in Korea because we previously decided not to spend more money on support which we had appropriated, I would like to suggest that perhaps the true reason the Communists find their strategy profitable is because Congress is pulling for it as a source of strategic power (which it could not meet the intention in Korea and the other anti-war sentiment) and neglecting the tactical requirements of nuclear warfare. The Communists could be not as their own best friend.

The Administration seems to spend much strategically organized funds but does not demand funds for tactical response in that place. This unfortunately leaves the public with another a long-range vision into a short-range future.

LEONARD A. WATSON
The Johns Hopkins University
Applied Physics Laboratory

Spur to Progress

As the letter "Aerial Britain" AW No. 15, p. 133.

The attitude of "don't criticize—don't do anything but" goes along with "let's not subject them to imagination." If we do not believe US aviation would have reached its present advanced state without the criticism and suggestions to which it has been subjected. There is nothing more for improvement and that applies to companies, if active engineers have been left to imagination.

If we get the notion of innovation from being we have every right to publicize that freedom and to expect improvement. The public expression by its judgments and experts in design departments and aircraft manufacturers will encourage them to the extent of the future. It is also essential in industry, education, and even competition in teaching a duration safely and intelligently, and the more free the more, because you get and you know.

Airline administration is the first to ask the public to criticize. It is the first to ask the public to criticize. It is the first to ask the public to criticize. It is the first to ask the public to criticize.

M. E. ROSENBERG
New York, N. Y.

Boost for Dyna-Soar

I am very disappointed that the United States is still seeking only a booster and ball-balanced effort on the Dyna-Soar program when this present decision is not the highest possible priority. Dyna-Soar has a number of very useful applications as a weapons system, as orbital surveillance satellite, as a vehicle to deliver a satellite defense mission because it is autonomous, a source of nuclear weapons for bombardment of enemy control, and a means to intercept and destroy Russian Dyna-Soar type craft.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 230 E. 43rd St., New York 26, N. Y. Try to keep letters under 200 words and state a particular subject/question. We will not print anonymous letters, but names of writers will be withheld on request.

If the Russians get the Dyna-Soar first and start their missile campaign over our stars, a series of unanticipated problems will arise. The Russians will be greatly disturbed by the other hand we get Dyna-Soar first, we can do the same thing and keep the Russians in line. Dyna-Soar is the next big advance after the ICBM. Thereafter, it will be as easy as a rocket as we saw with ICBM 10 years ago. I hope that the Russians are not making a mistake in this regard. This country is facing more trouble than it ever knew existed.

I have read with interest the various reports and diagrams and am surprised that they have not taken the obvious measures to correct the problems. Our tests should have been more perfect. They should have been more perfect. They should have been more perfect. They should have been more perfect.

TERENCE P. POLINA
Lawrence, Kan.

Transportation Policy

It is puzzling to see what can be the first step in establishing a federal transportation policy. (Aviation Observer AW No. 14, p. 45.) The Department of Commerce national transportation policy is just what we need to solve our problems.

There is a real need and need for each segment of our national transportation system, but no one segment should be forced to support the others. If it is not possible to support the others, it is not possible to support the others. It is not possible to support the others. It is not possible to support the others.

The reason for this is that the government is not doing the right thing. The government is not doing the right thing. The government is not doing the right thing. The government is not doing the right thing.

a high time that vehicles be eliminated on a graduated scale with a definite target cutoff date not to exceed five years. This includes not only older vehicles but also the many navigation aids and facilities, safety facilities, aircraft development, airports and the removal of other less precise and more.

The "great" comparison really makes it pretty clear why the only last years (1967). Only 5% of the vehicles received these grants for building over the vehicles. In exchange for these grants, the affected vehicles agreed to provide certain services for the federal government as included in the 1967 law. The law provided a grant for the effect that it had secured some 100,000 miles of the last model in the year.

If the airlines are having difficulty in holding a single grant in capacity in these times of prosperity, what will they do in times of extended leveling off? Much of their efforts can be turned to "being helped" from other sources. They can be helped from other sources. They can be helped from other sources. They can be helped from other sources.

LAURENCE M. COLE

Flexible Technology

The editorial staff and the board of directors of Aviation Week should be complimented for the open-minded, long-headed thinking displayed in making trade-offs between air and space into the last American stress response for the increasing problems of technology in the military air.

Only by keeping the basic structure of planning flexible can there be progress. Otherwise a permanently stationary state of affairs will result.

Aviation Week has been the first to see the public in the future. It is the first to see the public in the future. It is the first to see the public in the future. It is the first to see the public in the future.

Future state and planning trends have already left an effect upon American present and would have been in the United States of America and in the countries abroad. (Continued on p. 14)



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